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WESTERN COMMITTEE ON CROP PESTS

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1990 Report

WESTERN COMMITTEE ON CROP PESTS

Report of

Meeting Held at the

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Edited by:

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FOREWORD

This report supersedes previous reports and is valid for 1990 only.

The insecticides, rates, and restrictions are current and represent, in the opinion of the Committee, the best recommendations for the control of each pest. The report does not include all insecticides and rates registered in Canada for the purposes specified.

Only insecticides registered before 15 October 1989 are recommended. Insecticides not registered but otherwise acceptable to the Committee are listed in Appendix I of this report. Registered insecticides that, in the opinion of the Committee, require more efficacy data are included in Appendix II. Common names versus trade names of compounds used in this report are included as Appendix III.

Insecticides are listed alphabetically by their accepted common names for each pest. Rates are given as weights of active chemical unless otherwise stated.

Information concerning insect levels that may require control to prevent crop losses is included. Generally, no hard-and-fast rule is available. The interactions between the numbers of insects, their stages of development, the stage and density of the crop, and weather conditions results in large variations in the amount of damage that will occur. From the information required to provide valid information concerning many of our crop pests.

The Western Committee on Crop Pests meets annually to revise this report. The members represent Agriculture Canada, Environment Canada, Health & Welfare Canada, Departments of Agriculture of Manitoba, Saskatchewan, Alberta and British Columbia, Western Universities, and Crop Protection Institute of Canada. Technical advisers on pesticide registration also attend. Interested persons may apply to attend the meetings. The chairmen of sub-committees are listed in Appendix IV.

The information listed here is for the use of provincial and other agencies that issue recommendations for the control of insects and related pests of crops, home gardens, shelterbelts, ornamental trees and shrubs, households, and warehouses and farm-stored grain. Recommendations on livestock pests and plant diseases are provided respectively by the Western Committee on Livestock Pests and Western Committee on Plant Disease Control.

E. Thiessen Chairman	Henry S. Gerber Secretary

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CEREAL CROPS AND GRAIN CORN

O.O. Olfert and D.L. Johnson

APHIDS

Aphids

Economic Thresholds -

Control not required except with greenbug, until numbers exceed 50/plant before heading. (2-4)

Corn leaf aphid - Heavy infestations on barley caused severe damage before boot stage but no effect if infested after the boot stage. (5)

English grain aphid - 70/head reduced kernel weights of wheat in the milk and early dough stages by 8%. Populations of aphids decreased rapidly as the heads matured. (1,5)

Bird cherry oat aphid carrying barley yellow dwarf virus reduced yields of dry forage and protein of oats and barley by over 50%. The viruliferous aphids reduced height of barley and oats, the number of tillers of barley, and the leaf width of oats. (2) Herta barley infected with barley yellow dwarf virus transmitted by grain aphids had an average loss of 65% in the weight of seeds per infected head. (3)

Greenbug - 20 to 30 aphids on seedling plants can reduce yield by as much as 60%. Higher populations can kill plants. Greenbugs inject toxin into plant. The toxin and feeding damage leaves, retard root growth, cause stunting, abnormal tillering, and improper filling of heads. (6)

Russian wheat aphid - see Appendix II

Chemical Control -

	Rate AI/ha	Preharvest Interval	References
Barley, Oat, Rye & Wheat			
Demeton	210	45	1
Dimethoate ...	210	2	1
Malathion	700	7	5
Corn			
Malathion	1000-1400	5	-

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.
Demeton: Do not use on rye

References -

1. Harper, J. Econ. Entomol. 66:1326,1973.
2. Man. Dep. Agric., Pub. 227.
3. Minn. Dep. Agric., Minn. Pest Rep., 1976.
4. N. Dak. Dep. Agric., N. Dak. Pest Rep., 1977.
5. Wells and MacDonald, Can. J. Plant Sci. 41:866, 1961.
6. Kieckhefer and Kantack, J. Econ. Entomol. 73:582, 1980.

ARMYWORMS

Armyworm

Economic thresholds -

Control usually necessary when numbers exceed $10/m^2$. (1)

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
Barley, Oats and Wheat			
Carbaryl	1125-225	14	2
Malathion	560-1400	7	2
Methomyl	340	20	2
Trichlorfon ..	560	21	2
Rye			
Carbaryl	1125-2250	14	2
Malathion	560-140	7	2
Corn			
Methomyl	280-560	3	-

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.
Methomyl: Apply to corn as soon as young larvae appear and then at 3 to 5 day intervals.

References -

1. Man. Dep. Agric., Pub 227.
2. Smith, Pest. Res. Rep., 1976:177.

BROWN WHEAT MITE

Brown wheat mite

Cultural Control -
Summerfallow; rotation with non-cereal crops.

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
Chlorpyrifos		400	1

References -

1. Byers and Charnetski, Pest. Res. Rep. 1987 (In Press)

CUTWORMS: ARMY, PALE WESTERN, REDBACKED

Cutworms

Economic Thresholds -

Pale western cutworm at 8.4 larvae/m^2 caused 25% loss in wheat and at 30/m^2 caused 100% loss. Control is usually justified when larvae exceed 3-4/m^2. Economic thresholds for redbacked and army cutworm are somewhat higher at 5-6/m^2. Well established fall-seeded crops or spring seeded crops with good moisture conditions can tolerate higher numbers.

Cultural Control -
Reduce egg laying by pale western cutworm adults in summerfallow fields by destroying all plant growth in July and allowing field to crust until 15 September. Severely infested fields should be treated before reseeding. Attempts to starve the cutworms, particularly pale western cutworm, by delaying seeding often fail. In areas where redbacked cutworms are a problem, destroy weedy growth on fallow fields prior to August.

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
Chlorpyrifos	420-560	60	1-6,8,9
Deltamethrin (EC)	10	40	3-6,8,9
Permethrin	70	7	1,2,6-9

Use low rates when larvae are small, high rates later in the season or under dry conditions. Apply in evening if possible. Rain following application is beneficial.

Restrictions -

Chlorpyrifos: Apply only once per season; do not apply to rye.

Deltamethrin: Do not graze fields. Apply only once per season for cutworms. Do not use at temperatures above 25°C.

References -

ARMY CUTWORM

1. McDonald, J. Econ. Entomol. 72:277, 1979.

PALE WESTERN CUTWORM

2. McDonald, J. Econ. Entomol. 74:45, 1981.
3. Wise et al., Pest. Res. Rep. 1982:183,184
4. Wise, Pest. Rep. 1983:174.
5. Wise, Pest. Rep. 1984:189.
6. Charnetski and Byers, Pest. Res. Rep. 1985:185.
7. Hill and Byers, Pest. Res. Rep. 1985:183,186.
8. Byers and Charnetski, Pest. Res. Rep. 1986:129.

REDBACKED CUTWORM

9. McDonald, J. Econ. Entomol. 74:593, 1981.

EUROPEAN CORN BORER

European corn borer

Economic Thresholds -

Economic loss will occur when 50% of dryland grain corn plants show signs of leaf feeding (shot-holing) by newly hatched larvae. This does not appear to be the case with irrigated grain corn.

Reference -

1. Anonymous, Agdex 605 - 622, Manitoba Agriculture.

GRASSHOPPER

Grasshoppers

Economic Thresholds -

	No./m² Field	No./m² Roadside	
Control not usually required	0-6	0-12	
May be required	7-12	13-24	
Control required	13+	25+	(3)

Two-striped grasshoppers at $5/m^2$ from boot stage to maturity reduced yield of wheat by 25%. (6)

Ten grasshoppers/0.1 m^2 caged over wheat at 4-leaf stage destroyed the wheat in 72 hours. (4)

One grasshopper nymph/plant reduced yield by 25-44%. 11-27 $/m^2$ caused no damage, $45/m^2$ caused 27-43% loss in cage tests (5); $8/m^2$ clipped 20% of mature heads of wheat, and $16/m^2$ reduced yields by 23%, 65%, and 62% in 1975. (1)

Cultural Control -
No tillage methods will provide crop protection but fall stubble cultivation is recommended. Destroying green growth on stubble in the spring at the time of grasshopper hatching may help to starve the young hoppers.

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
Carbaryl (Sevin XLR)			
Barley, oats, wheat, rye.......	550-1125	14	-
Carbofuran			
Wheat, oats, barley	140	21	-
Corn	140	7	-
Chlorpyrifos; cereals			
Juveniles	280	60	13,14
Adults	420	60	5-7
Deltamethrin (EC)			
Aerial application	4-6	40	6,8
Ground Application	4-6	40	8
Deltamethrin (F)			
Aerial application	5-7.5	40	9-12
Ground application	5-7.5	40	-

	Rate (g AI/ha)	Preharvest Interval	References
Dimethoate (cereals only)			
Juveniles	210	2	4
Adults	420	21	4
Adults	490	28	-
Malathion			
Cereals & corn...	840	7	-

See Appendix II re: azinphos-methyl and methamidophos.

Restrictions -

Carbofuran:	Do not apply more than twice in one year on cereals.
Carbaryl (Sevin XLR):	Crop protection reduced under light canopy cover.
Deltamethrin:	Do not graze fields. Do not make more than 3 applications per year (only two applications per year by air). Do not use at temperatures above 25°C. Best control is obtained if application is made when the grasshoppers are in the 2 - 4 nymphal stage.
Malathion:	Do not apply at air temperatures below 20°C.

References -

1. Jacobson and Farstad, Can. Entomol. 73:158, 1941.
2. Man. Dep. Agric. Bull., Agdex 605.
3. Pickford and Mukerji, Can. Entomol. 106:1219, 1974.
4. Holmes et al., J. Econ. Entomol. 58:77, 1965.
5. Charnetski, Pest. Res. Rep. 1975:210.
6. McDonald, Pest. Res. Rep. 1974:7.
7. Rourke and Baudic Fehr, Pest. Res. Rep. 1985:171,176.
8. Stephen and Hagborg, Pest. Res. Rep. 1985:172.
9. Johnson et al., Pest. Res. Rep. 1985:174.
10. Reichardt et al., Pest. Res. Rep. 1986:124.
11. Stephen et al., Pest. Res. Rep. 1986:148.
12. Wise and Scholtz, Pest. Res. Rep. 1986:149.
13. Mackasey et al., Pest. Res. Rep. 1986:147.
14. Rourke and Buth, Pest. Res. Rep. 1986:125.

GREEN STINK BUG

Green Stink Bug

Economic Thresholds -
1/head of wheat causes losses exceeding 30%. (1)

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
Dimethoate	275	21	2

References -

1. Jacobson, Cargill Crop. Bull. 15: 35, 1940.
2. Jacobson and McDonald, Pest. Res. Rep. 1964: 209.

HESSIAN FLY

Hessian Fly

Death of individual wheat and barley tillers or of the entire plant may result if numerous larvae are present (more than several per plant). "Flaxseed" puparia may be found at the base of plants.

Cultural Control -
Seed tolerant or resistant varieties (see reference 1). If possible, delay fall seeding.

Chemical Control -
None.

References -

1. Maas et al. 1987. Crop Sci. 27:49-52.

ORANGE WHEAT BLOSSOM MIDGE

Orange wheat blossom midge

Damage -Infestations of 30, 60 and 90% reduced spring wheat yields by 40, 65 and 80% (1,4) (primarily Saskatchewan).

Cultural Control -

Seed alternate crops including barley. Farming practices which promote greater crop uniformity during heading and flowering (uniform seeding depth, higher seed rates to reduce tillering) reduce midge kernel damage but may not eliminate the need for chemical control.

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
Carbofuran	140	21	2,3,5
Chlorpyrifos	400-480	60	2,3,5
Dimethoate	480	21	2,3,5

When applied 3 to 6 days after oviposition begins, chlorpyrifos provides ca. 20-30% better kernel protection than carbofuran or dimethoate. Sprays should be applied in the late afternoon or evening when temperatures exceed 15°C and the wind speed is less than 10 km/ha. To obtain full benefits from insecticidal sprays, thorough coverage of the wheat heads is essential. In general, application methods which improve the uniformity and amount of spray deposited on wheat heads (higher water volumes, finer spray droplets, 45° nozzle orientation) provide better kernel protection and subsequent grade or yield improvements. Use the higher rate of Lorsban (Chlorpyrifos) 4E for aerial application, with water volumes of 20-35 L/ha. (6)

References -

1. Dexter et al., 1987. Can. J. Plant Sci. 67:697-712.
2. Elliot, 1988a. Can. Ent. 120:615-626.
3. Elliott et at., 1985. Can. Ent. 117:593-598.
4. Olfert et al., 1985. Can. Ent. 117:593-598.
5. Wise and Leader, Pest. Res. Rep. 1985:181-182.
6. Sask. Ag. Midge Bull. 1988. 2 pp.

THRIPS (barley, oat, wheat and corn)

Thrips

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
Dimethoate........	470-500	21	-
Malathion	560	7	-

Restrictions -
Malathion: Do not apply at air temperatures below 20°C.

WHEAT STEM SAWFLY

Wheat stem sawfly

Economic Thresholds -
Control required if 10-15% of crop in previous year is cut by sawfly. Infested stems of wheat averaged 17% (11-22%) loss in yield. (1)

Cultural Control -
Seed Canuck, Leader, Lancer, or other resistant wheats, or immune crops such as oat and flax. Early swathing will reduce losses.

Chemical Control -
No insecticides recommended.

References -

1. Holmes, Can. Entomol. 109:1591, 1977

WIREWORMS (Cereal and Corn)

Wireworms (cereal & corn)

Chemical Control -

	Rate	Preharvest Interval	References
Lindane (seed treatment)	0.5 g/kg grain	N/A	1,2
Turbufos 15G corn only	75g/100m row	N/A	3,6

Restrictions -

Lindane: Do not treat cereal seed if crop is to be used for forage. Do not mix treated seed with commercial grain. Do not allow poultry, livestock or wildlife to feed on treated seed.

CONSULT THE LABEL REGARDING STORAGE OF TREATED SEED. Insecticide-treated seed can be stored for 1 year, but storage periods vary with seeds having DUAL TREATMENTS (insecticide-fungicide).

Store treated seed away from other grain and in such a manner that it cannot be eaten by domestic animals or wildlife. Apply seed dressing at the rate recommended on the label.

Terbufos: Minimum 75 cm row spacing.

References -

1. Burrage and Saha, Can. J. Plant Sci. 47:114, 1967.
2. Burrage and Gurba, Can. J. Plant Sci. 47:665, 1967.
3. Wilkinson, Pest. Res. Rep. 1974:188.
4. Wilkinson, Pest. Res. Rep. 1975:111.
5. Annette and Allan, Pest. Res. Rep. 1981:155.
6. Annette and Killins, Pest. Res. Rep. 1982:176.

OILSEED CROPS

R.A. Butts

Note: 1) See page 16 - 1 re: "Hazards and Safeguards - Crops in Bloom".

2) For aircraft application of soluble powders, use a minimum of 11 L water/ha.

ALFALFA LOOPER (canola)

Alfalfa Looper

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
Chlorpyrifos...........	350-490	21	1-3
Methomyl...............	200-250	8	1-3

References -

1. Dolinski et al., Pest. Res. Rep. 1973:136.
2. Jacobson et al., Pest. Res. Rep. 1973:137.
3. McDonald, Pest, Res. Rep. 1973:252.

APHIDS (canola)

Aphids (canola)

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
Dimethoate	280-350	30	-

ARMY CUTWORM (canola & mustard)

Army Cutworm (canola and mustard)

Economic Threshold -
5/m^2 destroyed a mustard crop. (1)

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
Chlorpyrifos	420-560	21	-

References -
1. Jacobson, J. Econ. Entomol. 55: 408, 1962.

BEET WEBWORM (canola & flax)

Beet webworm (canola and flax)

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
Methomyl	250	8	-
Trichlorfon			
Canola	420	21	1,2
Flax	420	-	-

Restrictions -
Trichlorfon: Do not apply to flax after flowering.

References -
1. Putnam, Pest. Res. Rep., 1962:126.
2. Putnam, Pest. Res. Rep., 1977:274.

BERTHA ARMYWORM (Canola and Flax)

Bertha Armyworm (canola and flax)

Economic Thresholds -

Control usually necessary in canola and mustard when economic injury level is exceeded.

Economic Injury Levels (larvae/m^2)*, *Mamestra configurata*

$ cost/spray			$ value seed to producer						
		per bushel:	6	7	8	9	10	11	12
		per tonne:	265	309	353	397	441	485	529
per acre	per ha		larvae /m^2						
7	17		20	17	15	13	12	11	10
8	20		23	20	17	15	14	13	11
9	22		26	22	19	17	16	14	13
10	25		29	25	22	19	17	16	14
11	27		32	27	24	21	19	17	16
12	30		34	30	26	23	21	19	17

*Based on an average of 20 larvae/sq m consuming the equivalent of 65 kg canola seed/ha (1.16 bushels/acre). (10,11)

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
Chlorpyrifos canola only	350-490	21	1,4-9
Deltamethrin canola & mustard...	5-7.5	14	12-17
Methomyl	250	8	1-9
Methamidophos canola only	280-560	10	6-8

Restrictions -

Deltamethrin: Do not make more than three applications/yr. (Only one application/yr. by air. Do not apply at temperatures above 25^{0}C.

References -

1. Putnam, Pest. Res. Rep. 1970:126.
2. McDonald et al., Pest. Res. Rep. 1971:177.
3. Peterson et al., Pest. Rep. Rep. 1971:143.
4. Lee et al., Can. Entomol. 104:1745, 1972.
5. Stewart, Pest. Res. Rep. 1972:166.
6. Jacobson et al., Pest. Res. Rep. 1972:172.
7. McDonald, Pest. Res. Rep. 1973:257.
8. Jacobson et al., Pest. Res. Rep. 1973:138.
9. Harris and Turnbull, Can. Entomol. 107:865, 1975.
10. Bracken and Bucher, J. Econ. Entomol. 70:701, 1971.
11. Bracken and Bucher, Rep. Canola Council of Canada,1981.
12. Derksen and Blouw, Pest. Res. Rep. 1980:121,122, 123.
13. McVicar and MacKenzie, Pest. Res. Rep. 1980:124.
14. McVicar and Makowski, Pest. Res. Rep. 1980:125.
15. Wise and Kitson, Pest. Res. Rep. 1980:128.
16. Wise and McVicar, Pest. Res. Rep. 1980:129,130.
17. Wise, McVicar and Kitson, Pest Res. Rep. 1980:131.

CLOVER CUTWORM (canola)

Clover cutworm (canola)

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
Methomyl	250	8	1
Deltamethrin	5-7.5	14	2-5

References -

1. Dixon, Pest. Res. Rep. 1971:176.
2. Catellier & Wise, Pest. Res. Rep. 1982:99.
3. Catellier & Wise, Pest. Res. Rep. 1982:100.
4. McDonald, Pest. Res. Rep. 1975:260.
5. McDonald, Pest. Res. Rep. 1979:354.

CUTWORMS; PALE WESTERN & REDBACKED

Cutworms, Pale western, redbacked (canola flax & sunflowers)

Cultural Control -

In summerfallow fields, to prevent egg laying by pale western cutworm adults, destroy all plant growth in July and allow summerfallow to crust until September 15. In areas where redbacked adults are present, avoid weedy growth in August and weedy patches in crops. Starve young cutworm larvae before spring seeding by allowing volunteer growth to reach 2-5 cm before cultivation, then delay seeding 10-14 days.

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
Chlorpyrifos - (pale western and redbacked cutworms)			
Canola	425-560	21	1-5
Flax	425-560	100	1-5
- (redbacked cutworms)			
Sunflowers	560	100	1,2,4,5
Deltamethrin			
Flax	10	40	6,7

Restrictions -

Deltamethrin: Do not make more than 3 applications/yr. (Only one application/yr by air). Do not apply at temperatures above 25°C.

References -

1. McDonald, J. Econ. Entomol. 62:30, 1968;65:533, 1972.
2. Askew et al., Pest. Res. Rep. 1973:151.
3. McDonald, Pest. Res. Rep. 1974:251.
4. Askew et al., Pest Res. Rep. 1974:244.
5. Philip and Dolinski, Pest. Res. Rep.1977:215.
6. McVicar and Wise, Pest. Res. Rep. 1982:113.
7. Wise and Long, Pest. Res. Rep. 1985:95.

DIAMONDBACK MOTH (canola and mustard)

Diamondback moth (canola & mustard)

Economic Thresholds -

Control not required in canola until larvae exceed 300/m^2.(3)

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
Azinphos-methyl canola	300	0	1,2
Deltamethrin	5-7.5	14	4
Malathion	350	7	1
Methidathion canola	250	30	-
Trichlorfon canola	1120	21	1,2

Restrictions -

Deltamethrin:	Do not make more than three applications/yr. (Only one application/yr. by air).Do not apply at temperatures above 25°C.
Malathion:	Do not apply at air temperatures below 20°C.
Methidathion:	Do not feed or allow animals to graze on treated crops. Apply in minimum of 110 L water/ha by ground; or 22 L water/ha by air.

Do not apply when bees are present.

References -

1. Putnam, Pest. Res. Rep. 1962:126.
2. Putnam, Pest. Res. Rep. 1974:10 (re: possible resistance to insecticides).
3. Putnam, Agric. Can., Saskatoon, unpublished, 1976.
4. Wise and Leader, Res. Rep. 1985:84,85.

FLAX BOLLWORM

Flax bollworm

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
Methomyl	250	8	1

References -

1. Putnam, Pest. Res. Rep. 1974:180.

FLEA BEETLES (canola and mustard)

Flea beetles (canola & mustard)

Chemical Control -

In-Furrow and Seed-Coating Treatments

(These recommendations are for seed-drill application and are not valid for application with discer seeders.

Note - The lindane treatment may have to be followed by a post-emergence foliage spray about 7 days after seedling emergence).

	Rate (g AI/ha)	Preharvest Interval	References
Carbofuran (granular)	225-280	-	1-12
Lindane (seed dressing)	16 g/kg	-	1,3-9, 11,12
Terbufos (granular) (granules mixed with seed) ..	280-560	-	1-4, 11-17

Foliar Sprays

(Note: Yellow mustard seedlings are substantially resistant to flea beetle attack and should not require treatments with insecticides at seeding.)

	Rate (g AI/ha)	Preharvest Interval	References
BEFORE POD FORMATION:			
Azinphos-methyl			
Canola	70	30	1,3-5,8,12
Carbaryl			
Canola	540	-	
Carbofuran			
Canola	70-140	60	1,4,8,10,12
Mustard	70-140	21	-
Cypermethrin	35	30	20
Deltamethrin	5-7.5	14	19
Malathion			
Canola and Mustard	560	7	4
Methidathion			
Canola and Mustard	175	30	1,4,12
AFTER POD FORMATION:			
Malathion	560	7	-

Restrictions -

Azinphos-methyl: Do not apply when bees are foraging.

Carbofuran: Do not apply at 70 g/ha more than twice to the same crop, nor at the 140-g rate more than once.

Cypermethrin: Avoid application at temperatures above 27°C. Only one application per year by air.

Deltamethrin: Do not feed treated crop to livestock. Do not apply at temperatures above 25°C. Do not make more than 3 applications/yr. (Only one application/yr. by air).

Malathion: Do not apply at air temperatures below 20°C. Do not apply when bees are foraging.

Methidathion: Do not feed or allow animals to graze on treated crops. Apply in minimum of 110 L water/ha by ground; or 22 L water/ha by air.

References -

1. Putnam, Pest. Res. Rep. 1970:128; 1973:174; 1975: 166; 1976:132; 1977:147.
2. Swailes et al., Pest. Res. Rep. 1972:122; 1974:233.
3. Swailes and McDonald, Pest. Res. Rep. 1974:134.
4. Askew et al., Pest Res. Rep. 1974:226,228; 1976:127,129,131; 1977:144.
5. Palmer, Pest. Res. Rep. 1974:229; 1975:164.
6. Smith et al., Pest. Res. Rep. 1974:231.
7. Kolach and Bell, Pest. Res. Rep. 1975:161.
8. Westdal et al., Pest. Res. Rep. 1976:134,136.
9. Philip et al., Pest. Res. Rep. 1977:145.
10. Romanow et al., Pest. Res. Rep. 1977:151.
11. Westdal et al., Pest. Res. Rep. 1977:153,155; 1978:257; 1979:195; 1980:112.
12. Putnam, Can. J. Plant Sci. 57:987, 1977.
13. Volkers and Allison, Pest Res. Rep. 1979:203,208.
14. Philip and Steiner, Pest. Res. Rep. 1979:206.
15. Drew, Pest. Res. Rep. 1979:211; 1980:133.
16. Kneeshaw and Smith, Pest. Res. Rep. 1979:211; 1980:133.
17. Kneeshaw et al., Pest. Res. Rep. 1980:81.
18. Westdal et al., Pest. Res. Rep. 1980:115.
19. McVicar and Farnsworth, Pest. Res. Rep. 1982:97.
20. Romanow and Askew, Pest. Res. Rep., 1982:84, 1983:83.

GRASSHOPPERS

Grasshoppers

Cultural Control -

Tillage methods do not provide crop protection but fall stubble cultivation is recommended. Destroying green growth on stubble in the spring at the time of grasshopper hatching may help to starve young hoppers.

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
Carbaryl			
Canola	560	-	-
Carbofuran			
Canola	140	60	1,2
Flax, mustard and sunflowers	140	21	1,2

	Rate (g AI/ha)	Preharvest Interval	References
Malathion			
Canola, flax, and mustard	840	7	1
Methamidophos			
Canola	600	10	-

Restrictions -

Bee pastures: Do not apply when bees are present.

Carbofuran: Do not apply more than once per season.

Malathion: Do not apply at air temperatures below 20°C.

References -

1. Charnetski, Pest. Res. Rep. 1975:210.
2. McDonald, Pest. Res. Rep. 1975:248.

PAINTED LADY BUTTERFLY

Painted lady butterfly

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
Methidathion	525-700	50	1

Restrictions -

Methidathion: Do not feed or allow animals to graze on treated crops.

References -

1. Schulz, N.D. Agric. Exp. Sta., unpublished.

RED TURNIP BEETLE

Red turnip beetle

Cultural Control -

The eggs are dropped on the soil late in the summer, beneath canola or related plants. They hatch in the spring and the grubs feed on volunteer canola or winter annual weeds such as flixweed and mustards. Destruction of these food plants while the pest is still in the early grub stage may prevent development to adults, which are mobile.

Chemical Control -

Insecticides	Rate (g AI/ha)	Preharvest Interval	References
Azinphos-methyl			
Canola	140-200	30	1-4
Carbofuran			
Canola	140	60	3,4
Mustard	140	21	-
Methidathion			
Canola, and mustard............	260	30	3,4

Restrictions -

Carbofuran: Do not apply more than once per season.

Methidathion: Do not feed or allow animals to graze on treated crops. Apply in minimum of 110 L water/ha by ground or 22 L water/ha by air.

References -

1. Bowden, Pest. Res. Rep. 1972:123.
2. Dolinski and Philip, Pest. Res. Rep. 1972:165.
3. Westdal et al., Pest. Res. Rep. 1974:225.
4. Dolinski et al., Pest. Res. Rep. 1975:159.

SUNFLOWER BEETLE

Sunflower beetle

Economic Thresholds -

Control required with 1 adult/2-3 seedlings or over 10 larvae/plant. (1,3,10)

Severe leaf damage may occur to plants in the 2 to 6 leaf stage when adults are numerous, and on growing plants throughout the season when larvae are numerous.

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
Azinphos-methyl	280	-	2,4,7-9
Carbofuran			
Larvae	70	60	8
Adults	140	60	7,8
Cypermethrin	25	70	2,13
Endosulfan	560	60	1,3,5-7
Methidathion	260-525	50	6-8
Deltamethrin	5-7.5	70	11

Restrictions -

Do not apply insecticides after plants are 60 cm high or after heads begin to form.

Azinphos-methyl:	Do not apply more than twice per season, 7-14 days apart.
Carbofuran:	Do not apply more than 280 g/season. Do not apply by aircraft.
Cypermethrin:	Avoid application at temperatures above 27°C. (Only one application by air.)
Endosulfan:	Do not apply more than once per season. Do not feed treated foliage to livestock.
Methidathion:	Do not feed or allow animals to graze on treated crops.
Deltamethrin:	Do not make more than three applications/yr. (Only one application by air.) Do not apply at temperatures above 25°C.

References -

1. Kolach, Pest. Res. Rep. 1970:147.

2. Bergen et al., Pest. Res. Rep. 1972:138.
3. Kolach et al., Pest. Res. Rep. 1972:141.
4. Bowden, Pest. Res. Rep. 1973:156.
5. Palmer and Todd, Pest. Res. Rep. 1973:157.
6. Zirk and Donaghy, Pest. Res. Rep. 1973:158, 1974:247.
7. Askew et al., Pest. Res. Rep. 1974:245.
8. Westdal et al., Pest. Res. Rep. 1974:246.
9. Palmer, Pest. Res. Rep. 1975:181.
10. Man. Dep. Agric., Pub. 277.
11. Westdal et al., Pest. Res. Rep. 1981:130.
12. Romanow and Askew, Pest. Res. Rep. 1983:144.
13. Emilson, Pest. Res. Rep. 1983:141,142,143; 1984:160,161,162,163.

FORAGE CROPS

B.D. Schaber & M. Okuda

ALFALFA WEEVIL

Alfalfa weevil

Economic Thresholds

Alfalfa hay crops (6-10)

- 20-30 larvae/sweep for 12% leaf loss
- 50-75 larvae/sweep for 30% leaf loss
- 6 larvae/stem at peak of larval population for a return on treatment costs

Alfalfa seed Crops (11)

- 20-25 larvae/sweep (90°=straight sweep)
- 35-50% of foliage tips show damage

Cultural Control -

Cut the first hay crop early. If damage reappears in new growth, treat with insecticides immediately.

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
Azinphos-methyl ..	560-840	21	1,2
Carbofuran	260	7	3,6
Deltamethrin (seed crop only)	12.5	-	12,13
Malathion	1000-1400	7	1,2
Methidathion	280-560	10	4,5
Methoxychlor	1125-1400	7	1
Phosmet	1125	7	-

Forage Crop:	If application is made to heavy growth, 110-220 L water/ha may be required for adequate coverage.
Seed Crop:	For least hazard to bees use methoxychlor or deltamethrin. Hold leafcutter bees off the crop for at least 12 hours after methoxychlor application, or at least 24 hours after deltamethrin application.

Restrictions -

Crop in bloom:	Do not apply insecticide when bees are pollinating. See page 16 - 1 regarding hazard to bees.
Azinphos-methyl:	Do not apply more than once per cutting. Do not apply within 21 days of grazing or harvesting for forage.
Carbofuran:	Do not apply more than once per season.
Deltamethrin:	For use on seed crops only; do not feed treated crops to animals; one application per year. Do not apply by aircraft.
Malathion:	Do not apply at air temperatures below 20°C.
Methidathion:	Do not feed or allow animals to graze on treated crops.
Phosmet:	Do not apply more than once per cutting.

References -

1. Bass and Knapp, J. Econ. Entomol. 59:648, 1966.
2. Swailes and McDonald, Pest. Res. Rep. 1964:177.
3. Ellis, Pest. Res. Rep. 1976:167.
4. Richards and Charnetski, Pest. Res. Rep. 1976:168.
5. Harper, Can. Entomol. 110:891, 1978.
6. Cothran and Summers, Environ. Entomol. 3:891, 1974.
7. Dickason and Every, J. Econ. Entomol. 61:860, 1968.
8. Hastings and Pepper, J. Econ. Entomol. 46:785, 1953.
9. Hintz et al., J. Econ. Entomol. 69:759, 1976.
10. Koehler and Pimentel, Can. Entomol. 105:61, 1973.
11. Johansen, Pacific North West Ext. Publ. No. 128, 1980.
12. Charnetski and Schaber, Pest. Res. Pep. 1980:160.
13. Charnetski, Pest. Res. Rep. 1983:154.

BROMEGRASS SEED MIDGE

Bromegrass seed midge

Cultural Control -

Thorough burning of stubble and trash before regrowth in late summer, or in early spring, provides some, but not complete, control. (1-2)

References -

1. Neuman and Manglitz, Agric. Exp. Sta., Univ. Neb., Res. Bull. 252, 1972.
2. Knowles, Forage Notes 18(2), 1973; 19(2), 1974.

GRASSHOPPERS (alfalfa, clover and grasses)

Grasshoppers (alfalfa, clover & grasses)

Economic Thresholds - (See Cereal Crops, page 1 - 5)

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
Azinphos-methyl			
Alfalfa, clover	260-420	21	-
*Carbaryl	550-1125	0	-
Carbofuran			
Alfalfa	140	1	5
Grass (pastures)	140	1	-
Sweet clover	140	28	-
Deltamethrin (rangeland).	5-7.5		
Dimethoate...............	210-420	2-7	1-4
Dimethoate (in bait)	110-165	0	6
Malathion	840	7	-

*Data from XLR formulation.

Restrictions -
Crop in bloom:See page 16 - 1 regarding hazard to bees.

Azinphos-methyl: Do not apply more than once per cutting. Do not apply within 21 days of grazing or harvesting for forage.

Carbaryl (XLR formulation): Dilutions of higher than 1:11 are not recommended when residual insect control from the wash-off resistance is desired.

Carbofuran: Do not apply to pastures within 1 day of grazing or to sweet clover within 28 days, or alfalfa within 1 day of harvest or grazing, or sunflowers more than 60 cm high or heads forming. Do not apply more than twice per season.

Dimethoate:	Standing crops treated with 210 mL of dimethoate should not be grazed by dairy cattle until 2 days after treatment and with 420 mL. Do not graze or harvest within 7 days.
Malathion:	Do not apply at air temperatures below 20°C. Standing crops treated with malathion may be grazed immediately after treatment.

References -

1. Holmes et al., J. Econ. Entomol. 58:77, 1965.
2. Banham, Pest. Res. Rep. 1964:134.
3. McDonald and McKinlay, Pest. Res. Rep. 1964:132.
4. Dolinski and Boisvert, Pest. Res. Rep. 1973:185.
5. Mukerji, et al., Can. Ent. 1981:707.

PEA APHID (alfalfa)

Pea aphid (alfalfa)

Economic Thresholds -

1430 aphids/sweep did not reduce the forage yield of alfalfa. (2)

Caged alfalfa initially infested with 100-200 aphids/plant produced less forage and had lower carotene contents than uninfested plants. (4)

Cultural Control -

On irrigated alfalfa, control may be unnecessary if adequate water is provided to the plants. (2)

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
Deltamethrin...	7.5-10		
Demeton (for hay)......	280-325	21	-
Dimethoate	210	2	1,3
Malathion	700	7	1-3
Methidathion ..	280-560	10	1,3

Use 90-110 L water/ha to ensure thorough coverage. Treat if population is large enough to stunt plants or if heavily infested hay is to be dehydrated.

Restrictions -

Do not apply when pollinators are present. See page 16 - 1 re: hazard to bees.

Dimethoate: Do not graze or harvest alfalfa treated with dimethoate within 2 days of application.

Malathion: Do not apply when air temperature is below 20°C.

Methidathion: Do not feed or allow animals to graze on treated crops.

References -

1. Harper, Can. Entomol. 110:891, 1978.
2. Hobbs et al., Can. Entomol. 93:801, 1961.
3. McDonald and Harper, Can. Entomol. 110:213, 1978.
4. Harper and Lilly, J. Econ. Entomol. 59:1426, 1966.

PLANT BUGS (alfalfa seed fields)

Alfalfa plant bug, Superb plant bug, Lygus bug and Plagiognathus bug.

Economic Thresholds -

5 nymphs/sweep of any or all species of plant bugs, when the alfalfa is in bud or in bloom. (7-9)

Cultural Control -

Burning of alfalfa stubble and debris in early spring controls all species except lygus bugs. (3,5,15)

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
Deltamethrin ..	10	-	10-14
Dimethoate	560	28	1,6
Methidathion ..	280-560	10	6,14
Trichlorfon ...	1155	14	1,2,4,14

In burned fields for control of lygus bugs, apply dimethoate, methidathion or deltamethrin just before the alfalfa begins to bloom. Wait 7 days after applying dimethoate or methidathion; and wait 1 full day after applying deltamethrin before putting or replacing leafcutter bees on the crop.

In unburned fields for control of all plant bugs, apply dimethoate or methidathion when flower-buds are beginning to form.

If the alfalfa is in bloom and bees are in the crop, apply trichlorfon in late evening when bees are not foraging. This treatment is not recommended for the Peace River Region of Alberta.

Restrictions -

Deltamethrin:	Do not feed treated crop to animals; apply only once/yr.; do not apply by air.

References -

1. Craig, Pest. Res. Rep. 1971:167.
2. Kolach and Senkow, Pest. Res. Rep. 1972:151.
3. Lilly and Hobbs, Can. J. Plant Sci. 42:53, 1962.
4. Craig, Pest. Res. Rep. 1973:168.
5. Craig, Agric. Can. Pub. 1935, 1973.
6. Harper, Can. Entomol. 110:891, 1978.
7. Craig and Lasiuk, Pest. Res. Rep. 1971:167.
8. McMahon, Rep. B.C. Agron. Assoc. 1950:58.
9. Sorenson, Utah Agric. Exp. Sta.,Bull. 284,1939.
10. Charnetski and Schaber, Pest. Res. Rep. 1980:161.
11. Charnetski, Pest. Res. Rep. 1983:154.
12. Butts, Pest. Res. Rep. 1981:149; 1983:156.
13. Butts and Lippert, Pest. Res. Rep. 1982:166.
14. Cattellier and Wise, Pest. Res. Rep. 1982:167.
15. Schaber and Entz, Journ. Econ. Entomol. 81:668-672, 1987.

RED CLOVER THRIPS - red clover seed fields

Red clover thrips (red clover seed fields)

Economic Thresholds -

Damage insignificant unless 50-80 thrips/raceme are present. (1) Threshold levels only occur during years of early spring drought on dryland

Reference -

1. Craig, unpublished data 1987, Saskatoon.

SWEET CLOVER WEEVIL

Sweet clover weevil

Economic Thresholds (7) -

In seedling sweet clover crops:

1 weevil adult/5 seedlings in cotyledon stage under slow growth conditions.

1 weevil adult/3 seedlings in cotyledon stage under normal growth conditions.

In newly emerging 2nd year sweet clover:

9-12 weevil adults/plant.

Cultural Control -

Seedling stands:

Locate new seedlings as far as possible from 2nd-year clover.

First-year stands in late summer:

Defoliation of 1st-year clover by close-cutting, grazing, or weevil feeding during the critical period of mid-August to mid-September will severely reduce 2nd-year yield. Swath companion grain crops high.

Second-year stands:

2nd-year clover will usually outgrow weevil damage; insecticide application is rarely necessary. Sweet clover silage and hay fields should be cultivated as soon as possible after the crop is taken; this kills the new-generation weevil larvae in the soil. (6,7)

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
In sweet clover seedling crops			
Azinphos-methyl.....	420	21	2-4
Carbaryl	1125	1	2,3
Dimethoate	560	28	1-4

Apply insecticide when the very young seedlings are noticeably damaged by weevil feeding.

	Rate (g AI/ha)	Preharvest Interval	References
In 1st-year clover in late summer and fall			
Dimethoate	560	28	1
Malathion	700	N/A	5

Apply insecticide to crop margins where weevils are concentrated. Use malathion if the clover will be grazed or cut and fed or use dimethoate if not grazed or fed.

	Rate (g AI/ha)	Preharvest Interval	References
In 2nd-year crops			
Dimethoate	560	28	5

Restrictions -

Azinphos-methyl:	Do not apply more than once per cutting. Do not apply within 21 days of grazing or harvesting for forage.
Dimethoate:	Do not apply within 28 days of grazing or harvesting for forage.
Malathion:	Do not apply at air temperatures below 20°C. Dairy cattle should be removed when spraying but may be returned immediately.

References -

1. Craig, Pest. Res. Rep. 1971:179.
2. Craig, Pest. Res. Rep. 1964:136.
3. Craig, Pest. Res. Rep. 1965:135.
4. Swailes and McDonald, J. Econ. Entomol. 58:988, 1965.
5. Craig, Pest. Res. Rep. 1968: 150.
6. Bird, 80th Annual Rep., Entomol. Soc. Ont., 1949.
7. Craig, Can. Entomol. 110:883, 1978.

Special Crops

This section is currently under major review and will be included in the 1990 WCCP GUIDE.

HOUSEHOLD PESTS

M. Steiner and L. Harris

Homeowners are advised to purchase ready-to-use products. Use only those products labelled specifically for households. **Do not substitute those labelled only for gardens.**

ANTS

Ants

Chemical Control -	Rate
*Bendiocarb	0.125-0.25% in water or 1% dust
*Chlordane (carpenter ants)	2% spray or 5% dust
*Chlorpyrifos EC	0.25-0.50% spray
Chlorpyrifos (0.5% ready-to-use solution)	50 mL/m^2
Diazinon	0.5% coarse aerosol or 1% spray or 2% dust
*Diazinon (encapsulated)	0.5-1% spray
Propoxur	0.5-1% spray
*Pyrethrins (encapsulated)	0.25% spray
Resmethrin	0.25% spray

*Commercial use only.

Restrictions -
Avoid contamination of food, feedstuffs, and water supplies.

References -
1. Agric. Can., Pub. 1736/E.

BEDBUGS

Bed bugs

Chemical Control -	Rate
*Bendiocarb	0.25% in water or 1% dust
*Malathion (premium grade)	0.5% on mattresses and upholstery, 2% spray elsewhere
Pyrethrins	0.25-0.5% spray

*Commercial use only.

References -

1. Agric. Can., Pub. 1736/E.

BOXELDER BUG

Boxelder bug

Chemical Control -

	Rate
Methoxychlor (with pyrethrin and piperonyl butoxide)	aerosol - follow label
*Trichlorfon SN	1.25 g/L

*Commercial use only.

Restrictions -
Avoid contamination of food, feedstuffs, and other supplies.

References -

1. Mazurek et al., Proc. Entomol. Soc. Ont. 92:202,1961.

CARPET BEETLE

Carpet beetle

Chemical Control -

	Rate
*Bendiocarb	0.25% in water or 1% dust
*Chlorpyrifos EC	0.25-0.5% spray
Chlorpyrifos (0.5% ready-to-use solution)	50 mL/m^2
	Rate
*Diazinon (encapsulated)	0.5% spray
Diazinon	0.5-1% spray
*Malathion (premium grade)	3% spray
Methoxychlor (with pyrethrin and piperonyl butoxide)	aerosol - follow label
Propoxur	0.5-1% spray
*Pyrethrins (encapsulated)	0.08-0.22% spray

*Commercial use only.

Restrictions -
Avoid contamination of food, feedstuffs, and water supplies.

References -
1. B.C. Entomol. Circ. 20, 1962.
2. Agric. Can., Pub. 1202, 1974.
3. Robinson, Manitoba, personal observations.

CENTIPEDE AND MILLIPEDE

Centipede and Millipede

Chemical Control -	Rate
*Bendiocarb	0.25% in water or 1% dust
Carbaryl (outdoors)	1-2% spray or 5% dust
Diazinon	0.5%-1% spray
Malathion (outdoors)	3% spray
Propoxur (outdoors)	1% spray-to surface of buildings
*Pyrethrins (encapsulated)	0.08-0.22% spray
Resmethrin	0.25% spray

*Commercial use only.

Restrictions -
Avoid contamination of food, feedstuffs, and water supplies.

References -
1. Agric. Can. Publ. 1736/E.
2. Mallis, Handbook of Pest Control, 1969.

CLOTHES MOTH

Clothes moth

Chemical Control -	Rate
*Bendiocarb	0.25% in water or 1% dust
Diazinon	0.5-1% spray
*Malathion (premium grade)	3% spray
Methoxychlor	2-3% pressurized spray
Propoxur	0.5-1% spray
*Pyrethrins (encapsulated)	0.08-0.22% spray

*Commercial use only.

Restrictions -
Bendiocarb: Do not apply to clothing.

References -

1. Agric. Can., Pub. 1736/E.

CLOVER MITE

Clover mite

Chemical Control -	Rate
*Diazinon (encapsulated)	0.5% spray
Diazinon 12% EC	7.8 mL/L
Dicofol 18.5% EC	7.8 mL/L
Malathion 50% EC (outdoors)	23 mL/L
Methoxychlor (with pyrethrin and piperonyl butoxide)	aerosol - follow label
Propoxur	0.5-1% spray

*Commercial use only.

Apply sprays to grass and outside walls. Use vacuum cleaner indoors. Grass-free barrier of 45-60 cm next to house is effective means of preventing invasion.

Restrictions -

Avoid contamination of food, feedstuffs, and water supplies.

Propoxur: Use indoors, not on vegetation.

References -

1. English and Snetzinger, J. Econ. Entomol. 50:135, 1957.
2. MacNay, Agric. Can., Pub. 934, 1963.

COCKROACH

Cockroach

Chemical Control -	Rate
*Bendiocarb	1% dust
*Chlorpyrifos EC	0.25-0.5% spray
Chlorpyrifos (0.5% ready-to-use solution)	50 mL/m^2
*Diazinon (encapsulated)	0.25% spray (maintenance treatment) 0.5%-1% spray (cleanout treatment)
Diazinon	0.5% spray or 2% dust

*Malathion (premium grade)	2% spray or 4% dust
Methoxychlor (with pyrethrin and piperonyl butoxide)	aerosol - follow label
Propoxur	1% spray
*Pyrethrins (encapsulated)	0.08-0.22% spray
Resmethrin	0.25% spray
*Ronnel (with synergized pyrethrins)	1-1.5% spray
Rotenone	1% dust
Silica gel (with pyrethrin and piperonyl butoxide)	40% dust

*Commercial use only.

Restrictions -
Avoid contamination of food, feedstuffs, and water supplies.

References -
1. Agric. Can., Pub. 1736/E.

CRICKETS

Crickets

Chemical Control -	Rate
*Bendiocarb	0.125-0.25% in water or 1% dust
Carbaryl (outdoors)	5% dust
*Chlorpyrifos EC	0.25-0.5% spray
Chlorpyrifos (0.5% ready-to-use solution)	50 mL/m^2
Diazinon	0.5-1% spray or 2% dust
Malathion (outdoors)	4% dust
Methoxychlor	2-3% spray or 5% dust
Methoxychlor (with pyrethrin and piperonyl butoxide)	aerosol - follow label
Propoxur	1% spray
*Pyrethrins (encapsulated)	0.08-0.22% spray
*Ronnel (with synergized pyrethrins)	1-1.5% spray

*Commercial use only.

Restrictions -
Avoid contamination of food, feedstuffs, and water supplies.

References -
1. Agric. Can., Pub. 1736/E.

EARWIG

Earwig

Chemical Control -

	Rate
Bendiocarb	0.25% in water or 1% dust
Carbaryl (outdoors)	1% spray or 5% dust
*Chlorpyrifos EC	0.25-0.5% spray
Chlorpyrifos (0.5% ready-to-use solution)	50 mL/m^2
*Diazinon (encapsulated)	0.5-1% spray
Diazinon	0.5-1% spray
*Malathion(premium grade)	3% spray
Methoxychlor	5% dust
Propoxur	1% spray
Resmethrin	0.25% spray

*Commercial use only.

Restrictions -

Carbaryl, methoxychlor: Do not use indoors.

Avoid contamination of food, feedstuffs, and water supplies.

References -

1. Agric. Can., Pub. 1752 E.

FLEAS

Fleas

Chemical Control -

	Rate
*Bendiocarb	0.25% in water or 1% dust
*Chlorpyrifos EC	0.25-0.5% spray
Chlorpyrifos (0.5% ready-to-use solution)	50 mL/m^2
*Diazinon (encapsulated)	0.5% spray
Diazinon	0.5% spray or 2% dust
*Malathion (premium grade)	3% spray
Methoxychlor	1% spray
Propoxur	1% spray
*Pyrethrins (encapsulated)	0.08-0.22% spray
Resmethrin	0.25% spray

*Commercial use only.

Restrictions -

Avoid contamination of food, feedstuffs, and water supplies. Do not apply to pets or animals. Several flea powders are available for animals.

References -

1. Agric. Can., Pub. 1736 E.

HOUSE FLIES

House flies

Chemical Control -

	Rate
Dichlorvos (slow-release strip or block)	follow label
*Malathion (premium grade)	3% spray
*Pyrethrins (encapsulated)	0.08-0.22% spray
Pyrethrins	aerosol or space spray
Resmethrin	0.25% pressurized spray

Restrictions -

Avoid contamination of food, feedstuffs, and water supplies.

References -

1. Agric. Can., Pub. 1736/E.

SILVERFISH

Silverfish

Chemical Control -

	Rate
*Bendiocarb	0.125-2.5% in water or % dust
*Chlorpyrifos EC	0.25-0.5% spray
Chlorpyrifos (0.5% ready-to-use solution)	50 mL/m^2
*Diazinon (encapsulated)	0.5-1% spray
Diazinon	1% spray or 2% dust
*Malathion (premium grade)	2% spray
Methoxychlor	0.5-1% spray
Methoxychlor (with pyrethrin and piperonyl butoxide)	aerosol - follow label
Propoxur	1% spray
*Pyrethrins (encapsulated)	0.08-0.22% spray

*Commercial use only.

Restrictions -

Avoid contamination of food, feedstuffs, and water supplies.

References -

1. Agric. Can., Pub. 1736/E.

SOWBUG

Sowbug

Chemical Control -	Rate
*Bendiocarb	0.25% in water or 1% dust
*Chlorpyrifos EC	0.25-0.5% spray
Chlorpyrifos (0.5% ready-to-use solution)	50 mL/m^2
Diazinon	0.5% spray
*Malathion (premium grade)	2% spray
Propoxur	1% spray
Resmethrin	0.25% spray

*Commercial use only.

Restrictions -

Avoid contamination of food, feedstuffs, and water supplies.

References -

1. Agric. Can., Pub. 1736/E.

SPIDERS

Spiders

Chemical Control -	Rate
*Bendiocarb	0.25% in water or 1% dust
Chlorpyrifos	0.25% spray
Propoxur	0.5-0.84% aerosol or 1% spray
Pyrethrins	aerosols - follow label

*Commercial use only.

STORED FOOD INSECTS

Confused flour beetle, Granary weevil, Indian meal moth, Larder beetle, Mediterranean flour moth, Merchant grain beetle, Spider beetle, Yellow mealworm

Cultural Control -
Removal of food residues and thorough cleaning of infested areas is necessary to prevent reinfestations.

Chemical Control -	Rate
*Malathion (premium grade)....	2% spray
Propoxur......................	1% spray
Pyrethrins....................	0.15% spray
*Pyrethrins (encapsulated)....	0.08-0.22% spray

*Commercial use only.

Restrictions -
Do not use as space spray. Do not contaminate food, utensils, or surfaces that will contact foods.

References -
1. Agric. Can., Pub. 1736/E.

STRAWBERRY ROOT WEEVIL

Strawberry root weevil

Chemical Control -	Rate
Malathion 50% EC (outdoors)...	1.6 mL/L
Methoxychlor EC...............	5% spray

Apply spray to lawn and ground around building foundation.

References -
1. MacNay, Agric. Can., Pub. 1333, 1967.

WASPS

Wasps

Chemical Control -	Rate
*Bendiocarb	0.25% in water or 1% dust
Malathion (outdoors)	2% spray
Methoxychlor (with permethrin and piperonyl butoxide)	aerosol - follow label
Propoxur	0.5% pressurized pencil spray
Resmethrin	0.25% spray

*Commercial use only.

Restrictions -
Avoid contamination of food, feedstuffs, and water supplies.

References -
1. Agric. Can., Pub. 1736/E

HOME VEGETABLES CROPS

L. Harris

The pesticides listed below for the home vegetable garden usually are available in small package sizes. Adhere to the wait periods to harvest and other restrictions given on the container label.

NOTE: Recommendations are in terms of formulated product, not active ingredient.

APHIDS

Aphids

Cultural Control -

Do not spray if large numbers of ladybugs or lacewings are present on the plants.

Chemical Control -	Rate
Diazinon 12.5% EC	7.8 mL/L
Dimethoate 240 EC	0.4-1.6 mL/L
Endosulfan	2-5% dust
Malathion 50% EC	1.6 mL/L
Rotenone or pyrethrins, near harvest.	

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

COLORADO POTATO BEETLE

Colorado potato beetle

Chemical Control -	Rate
Carbaryl 50% WP	3.9 mL/L
Diazinon 12.5% EC	7.8 mL/L
Endosulfan	2-5% dust
Malathion 50% EC	1.6 mL/L
Methoxychlor 25% EC	9.7 mL/L
Rotenone	1% dust

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

CUTWORMS (Subterranean)

Cutworms (subterranean)

Cultural Control -

Removal of vegetable trash and weeds in August will reduce the incidence of cutworms the next year.

Chemical Control -

	Rate
Chlorpyrifos 0.5% G	40 g/m^2
Chlorpyrifos 10% EC	1.25 mL/m^2
Diazinon 5 G	10 g/m^2

Broadcast and incorporate into the soil before planting or shake around plants.

Restrictions -

Chlorpyrifos: Use only once per season 70 days before harvest and not on bunching onions.

FLEA BEETLES

Flea beetles

Chemical Control -

	Rate
Carbaryl 50% WP	7.8 mL/L
Diazinon 12.5% EC	7.8 mL/L
Endosulfan	2-5% dust
Malathion 50% EC	7.8 mL/L
Methoxychlor 25% EC	9.7 mL/L
Rotenone	1% dust

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

GRASSHOPPERS

Grasshoppers

Chemical Control -

	Rate
Carbaryl 50% WP	7.8 mL/L
Dimethoate 240 EC	1-2 mL/L
Malathion 50% EC	1.6 mL/L

Restrictions -
Malathion: Do not apply at air temperatures below 20°C.

LOOPERS: CABBAGE WORMS, DIAMONDBACK MOTH & OTHER CATERPILLARS

Loopers: Cabbage worms, Diamondback moth, and Other caterpillars

Biological Control -
Bacillus thuringiensis (var. *kurstaki*) follow label instructions.

Chemical Control -

	Rate
Carbaryl 50 WP	7.8 mL/L
Diazinon 12.5% EC	7.8 mL/L
Endosulfan	2-5% dust
Malathion 50% EC	3.9 mL/L
Methoxychlor 25% EC	9.7 mL/L
Rotenone	1% dust

Restrictions -
Malathion: Do not apply at air temperatures below 20°C.

ONION MAGGOT

Onion maggot

Cultural Control -
Remove and destroy all crop debris immediately after harvest.
Delay transplanting Spanish onions until 10 June.

Chemical Control -

	Rate
Diazinon 5 G (in furrow at planting) .	10 g/10 m row
*Diazinon 12.5% EC (drench)	7.8 mL/L
Ethion 2.5% G (in furrow at planting).	4.0 g/m row

Apply drench treatments to emerging seedlings or transplant the last week in May.

Restrictions -
Commercial use only.

ROOT MAGGOTS (crucifers)

Root maggots (crucifers)

Cultural Control -
Remove and destroy all crop debris immediately after harvest.

Chemical Control -

	Rate
Diazinon 5 G (in furrow but not in contact with seed)	30 g/10 m row
Diazinon 5 G (transplants)	3 g/plant
Diazinon 12.5% EC (drench)	7.8 mL/L

For cabbage and radish maggot, apply drench treatments after emergence and again from late July to mid-August.
For turnip maggot, apply drench in early and late July.

SLUGS

Slugs

Cultural Control -
Remove all vegetable trash and other debris from in and around gardens. Place boards between rows and collect and destroy the slugs that gather under them each morning.

Chemical Control -

Carbaryl bait: place around plants.
Metaldehyde: liquid bait or pellets. **Do not contaminate edible portion of the plants.**
Methiocarb : scatter 500 g/m^2 over foliage or soil.

TUBER FLEA BEETLE

Tuber flea beetle

Chemical Control -

	Rate
Sevin 50 WP	9 ml/l
Methoxychlor 25 EC	6 ml/l

Apply when adult beetles first appear or when feeding damage is visible on the leaves.

WHITE GRUBS

White grubs

Cultural Control -
Avoid planting in recently cultivated soil: leave dormant for one growing season to avoid problems.

Chemical Control -

	Rate
Diazinon 5 G	10 g/m^2

Broadcast and incorporate into the top 7-15 cm of soil before seeding.

WIREWORMS (Potatoes)

Wireworms (potatoes)

Cultural Control -
Avoid planting potatoes in soil which has been in sod or sown to grasses for at least 3 years after cultivating.

COMMERCIAL VEGETABLE CROPS

R.S. Vernon and J. McCullough

CAUTION

Crops such as potatoes, carrots, radishes, and onions grown in soils treated with chlordane, aldrin, dieldrin, or heptachlor in recent years may contain unacceptable residues. Do not feed to livestock.
The waiting period will vary with insecticide and crop.

APHIDS

Aphids

Chemical Control -

	Rate (g AI/ha)	Pre-harvest interval	Crop	References
Carbofuran	540	7	potato	2,7
Dimethoate	140-200	3	pea, field	
	280-325	3	pea, chard, kale, lettuce, spinach	
	280-325	12	beet	
	280-560	4	broccoli, cabbage, cauliflower	8
	280-560	7	bean	
	280-560	21	brussel sprouts	8
	280-675	7	potato, tomato	5
	500-1000	21	asparagus	12
Disulfoton	1100	180	asparagus	12
Endosulfan	560-1200	2	tomato	
	560-1200	5	broccoli, brussel sprouts, cabbage, cauliflower	
	560-1400	2	bean	
	840-1200	5	lettuce, spinach	
	840-1400	5	pea, potato	2
	1125	50	corn	
Fenvalerate	70-100	7	potato	9

	Rate (g AI/ha)	Pre-harvest Interval	Crop	References
Malathion	560-1400	3	broccoli, egg plant, pepper	
	560-1400	7	brussel sprouts, beet, cabbage, carrot, cauliflower, radish, turnip	
	700-1000	3	tomato, potato	
	700-1400	1	bean	
	700-1400	3-14	field lettuce	
	700-1400	7-21	greenhouse lettuce	
	1000	3	pea, cucumber, celery, field pea	6
	1000-1400	5	corn	
	1400-1750	7	spinach	
Methamidophos	560-1125	7	cabbage, cauliflower	3
	560-1125	14	broccoli, brussel sprouts, head lettuce	3
	840-1000	14	potato	2,4
Oxydemeton-methyl	560	180	asparagus	12
Pirimicarb	70-140	6	peas	1
	210-280	7	potato	4
	280	3	corn (sweet)	-
	150-250	7	lettuce	10
	250	7	asparagus	12

Restrictions -

Fenvalerate: Do not apply to crops grown in low lying or wet soils.

Malathion: Do not apply at air temperatures below 20°C

Economic thresholds -

Take 25, 180° sweeps at four locations in the field at first bloom. Treat if average number of aphids/sweep exceeds 15 - 20.

References -

1. Baillargeon, Pest. Res. Rep. 1978:193.
2. Campbell and Finlayson, Can. J. Plant Sci. 56:869,1976.
3. Finlayson, Can. J. Plant Sci. 59:399,1978.
4. Finlayson and Mackenzie, Pest, Res. Rep. 1978:243.
5. Huston, Pest. Res. Rep. 1974:217.
6. McLanahan and Founk, Pest. Res. Rep. 1975:105.
7. McLanahan and Founk, Pest. Res. Rep. 1975:124.
8. MacCarthy, Proc. Entomol. Soc. B.C. 59:5, 1962.
9. Ritcey et al., Pest. Res. Rep. 1978:234.
10. Mackenzie and Vernon, Pest. Res. Rep. 1982:115.
11. Lamb and Maiteki, Canadex: Pea aphid control on field peas.
12. Vernon and Houtman, J. Entomol. Soc. B.C. 1983:80.

ASTER LEAFHOPPER (lettuce)

Aster leafhopper (lettuce)

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
Malathion	1125	7-14	1
Phorate	1125	-	1

Restrictions -

Malathion: Spray twice weekly starting at insect emergence. Do not treat within 14 days of harvest of leaf lettuce, 7 days on head lettuce. Do not apply at air temperatures below 20°C.

Phorate: Use at seeding or transplanting only. Do not place phorate in contact with seed.

References -

1. Richardson and Westdal, Can. J. Plant Sci. 44:393, 1964.

COLORADO POTATO BEETLE

Colorado potato beetle

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
*Azinphos-methyl	280-420	7	3
Carbaryl	560	7	5
+Carbofuran	210	7	3,5
Deltamethrin	5-7.5	23	1,2,6,8
*Endosulfan	560	1	5
Fenvalerate	30-45	7	4
Methamidophos	840-910	14	5
Methidathion	280	14	3,5
Permethrin	78-105	1	--

Azinphos-methyl and endosulfan rates may be halved if row crop equipment is used and adequate coverage achieved.

+In 220 L water/ha.

Restrictions -

Fenvalerate: Do not apply to crops grown in low-lying or wet soils.

Deltamethrin: Only 2 applications by air.

References -

1. Catellier and McVicar, Pest. Res. Rep. 1982.
2. Dobson and McLean, Pest. Res. Rep. 1980:93.
3. McDonald, Pest. Res. Rep. 1973:254.
4. Pitblado, Pest. Res. Rep. 1978:222.
5. Rioux, Pest. Res. Rep. 1972:109.
6. Westdal et al., Pest. Res. Rep. 1980:100.
7. Westdal et al., Pest. Res. Rep. 1981:96.
8. Wise and McVicar, Pest. Res. Rep. 1981:97.

CUTWORMS -(redbacked)

Cutworms - redbacked

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	Crop
Chlorpyrifos .... (liquid formulation)	560-1125	30	rutabaga,
		32	cabbage,
		32	broccoli,
		32	brussel
		32	sprouts,
		32	chinese
		32	cabbage,
		40	pepper
		32	cauliflower
		60	cucumber
		60	carrot,
		70	celery,
		60	bulb onion,
		7	potato,
		70	tomato
		70	sweet corn
		70	field corn

EUROPEAN CORN BORER

European corn borer

Chemical Control -

	Rate g AI/ha	Preharvest Interval	References
Carbaryl	2250	1	1
Methomyl	560	3	2
Permethrin	100-140	1	2

Restrictions -
Treated crop should not be used as green feed for animals.

References -

1. Pitblado, Pest. Res. Rep. 1978:180.
2. Pitblado, Pest. Res. Rep. 1978:181.

FLEA BEETLES

Flea beetles

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	Crop	References
Carbofuran ...	525	7	potato	1,3
Diazinon	560	10	radish, parsnip,	--
			salsify potato, turnip (rutabaga)	14
Endosulfan ...	560-1000	2	cucumber, melon, pumpkin, squash	--
	560-1200	2	egg plant, pepper, tomato	--
		7	broccoli, brussel sprouts, cabbage, cauliflower	--
	560-1400	1	potato	2
	850-1200	45	turnip	--
Fenvalerate ..	30-45	7	potato	3
Malathion	560-1400	7	radish	--
Methamidophos	840-1125	14	potato	--
Methidathion .	275	14	potato	1,3
Permethrin ...	75-105	1	potato	--

Restrictions -

Fenvalerate: Do not apply to crops grown in low-lying or wet soils.

Malathion: Do not apply when air temperature is below 20°C.

References -

1. McEwan et al., Pest. Res. Rep. 1975:129.
2. Rioux, Pest. Res. Rep. 1973:129.
3. Ritcey et al., Pest. Res. Rep. 1978:234.

GRASSHOPPERS

Grasshoppers

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	Crop	References
Carbofuran	140	7	corn	--
Malathion	840	-	--	--

Restrictions -

Check label for interval required between application and harvest.

Malathion: Do not apply at air temperatures below 20°C.

IMPORTED CABBAGEWORMS, DIAMONDBACK MOTH, LOOPERS

Imported cabbageworm, Diamondback moth, Loopers

Biological Control -

	Rate (g AI/ha)	Preharvest Interval	Crop	References
Bacillus thuringiensis (Berlinger) 7.26 x 10^9 I.U./lb	560-1125	0	Broccoli, brussel sprouts, cabbage, cauliflower	1,4,5

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	Crop	References
Deltamethrin ..	7.5-10	3	broccoli brussel sprouts, cauliflower, cabbage	1,3,6,9-13
Diazinon	560	7	broccoli, brussel sprouts, cabbage, cauliflower	5
Endosulfan	840-1125	7	broccoli, brussel sprouts, cabbage, cauliflower	4,8

	Rate (g AI/ha)	Preharvest Interval	Crop	References
Fenvalerate ...	50-100	14	brussel sprouts,	3
Fenvalerate ...	50-100 (con't)	14	cabbage, cauliflower	
Methamidophos .	560-1125	7	cabbage, cauliflower	2,7,8
		14	broccoli, brussel sprouts	--
Methomyl	280-560	7	broccoli, brussel sprouts, cabbage, cauliflower	2,7,8 2,7,8
Permethrin	35-70	3	brussel sprouts, cabbage, cauliflower	2
		7	broccoli	--
Rotenone ...... (1% dust)	22.5 kg/ha	--	--	--

Restrictions -

Permethrin: Treated crop should not be used as green feed for animals.

References -

1. Brown et al., Pest. Res. Rep. 1980:70.
2. Finlayson, Can. J. Plant Sci. 59:399,1979.
3. Finlayson, Pest, Res. Rep. 1980:68.
4. Harcourt and Cass, Pest. Res. Rep. 1963:90.
5. MacCarthy, Proc. Entomol. Soc. B.C. 59:5,1962.
6. McEwan and Ritcey, Pest. Res. Rep. 1973:84.
7. Rioux, Pest. Res. Rep. 1973:80.
8. Sears and McGraw, Pest. Res. Rep. 1980:69.
9. Sears and McGraw, Pest. Res. Rep. 1980:77.
10. Sears and McGraw, Pest. Res. Rep. 1981:72.
11. Wise and Blouw, Pest. Res. Rep. 1981:68.
12. Mackenzie and Vernon, Pest. Res. Rep. 1981:63.
13. Mackenzie and Vernon, Pest. Res. Rep. 1982:67.

ONION MAGGOT

Onion maggot

Chemical Control -

Furrow treatments (kg AI/ha)

	Onions for sets	Table onions	Greenhouse onions	References
Diazinon	2.75-3.35	1.68	1.68	1,2,4
Ethion	2.75-3.35	1.68	1.68	2-4
Fensulfothion .	0	1.13	0	3
Fonofos	1.1	1.1	1.1	-

Insecticide granules should be applied to rows spaced at 40 cm, with a positive feed Gandy-type applicator calibrated for correct delivery. Apply granules in the furrow with the seed.

Restrictions -

Fonofos:	Organic soils only 10% O.M.
Fensulfothion:	Do not use on green bunching onions.

Drench treatments (kg AI/ha)

	Onions for sets	Table onions	Greenhouse onions	References
*Diazinon	0	1.13-2.25	1.13-2.25	--

*For soil drench, use 1100 L water/ha (7-9.5 g diazinon/10 L water/100 m of row).

Life cycles differ in various areas, spray programs must be scheduled to obtain maximum efficacy.

References -

1. Allen and Ashraff, Pest. Res. Rep. 1967:103.
2. Finlayson, Proc. Entomol. Soc. B.C. 62:3,1965.
3. McEwen et al., Pest. Res. Rep. 1970:103.
4. Perron, Can. J. Plant Sci. 42:616,1962.

POTATO LEAFHOPPER, PLANT BUGS (potato)

Potato leafhopper, Plant bugs (potato)

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	Crop	References
Fenvalerate ...	30-95	7	--	2
Methidathion ..	275	14	--	1,2
Permethrin	75-105	1	--	--

References -

1. McEwen et al., Pest. Res. Rep. 1975:129.
2. Ritcey et al., Pest. Res. Rep. 1978:234.

ROOT MAGGOTS (rutabagas and other crucifers)

Root maggots (rutabagas and other crucifers)

Chemical Control -
Band treatment (direct seeded crop)

	Rate (g AI/ 1000 m row	Crop	References
Carbofuran	175	rutabaga	3-5,7
Chlorfenvinphos	175	broccoli, brussel sprouts, cabbage, cauliflower, rutabaga	1,3-5,7
Chlorpyrifos	90-150	brussel sprouts, rutabaga	8
Diazinon (in-furrow)	90	radish in muck soil	2,6
Fensulfothion	175	broccoli, brussel sprouts, cabbage, cauliflower, rutabaga	1,3-5,7

Work granules into top 2 cm of soil in a 15-cm band, seed down centre, or apply with a Gandy applicator by placing the delivery fan in front of the seed coulter. The granules are applied and incorporated by the bow-wave action of the seeder.

Drench treatment

	Rate (kg AI/ha)	Preharvest Interval	Crop	References
Carbofuran	2.25	40	rutabaga	3-5,7
Chlorfenvinphos	2.25	40	brussel sprouts, broccoli, cabbage, cauliflower, rutabaga	3-5,7
Chlorpyrifos ...	1.7	32	broccoli, cabbage, cauliflower, brussel sprouts, rutabaga	8
Diazinon	1.40	10	radish in mineral soil	2,6
Fensulfothion ..	2.25	40	brussel sprouts, broccoli, cabbage, cauliflower, rutabaga	3-5,7

Apply drench when seedlings first emerge. Additional treatments; apply at 1100-1700 L of solution/ha.
Life cycles -- These differ in various areas and spray programs must be scheduled to obtain maximum efficacy.

Caution -

Chlorfenvinphos: Severe burning of foliage may result, especially when solution is poorly agitated or low volume of water is used.

Restrictions -

Carbofuran: Drench-applied; one at 45 days or two at 30 and 60 days after seeding.

Chlorfenvinphos: One drench 45 days after seeding.

Chlorpyrifos: Rate based on 60 cm row spacing. Apply 1 drench application 7-10 days after seeding or 3 days after transplanting.

Diazinon:	Drench-applied; in mineral soil, one when half the radish seedlings have emerged, a second 15 days later; in muck soil, one at 15-20 days after seeding.
Fensulfothion:	Drench-applied; one at 45 days or two at 30 and 60 days after seeding.

References -

1. Finlayson, Can. J. Plant Sci. 59:399,1979.
2. Finlayson and Noble, Proc. Entomol. Soc. B.C. 61:11, 1964.
3. Finlayson and Noble, Plant Sci. 46:459:1966.
4. Finlayson et al., J. Econ. Entomol. 60:132,1967.
5. McDonald and Swailes, Pest. Res. Rep. 1971:146.
6. Beausoleil and Ritchot, Pest. Res. Rep. 1975:156.
7. Swailes and McDonald, Pest. Res. Rep. 1969:156.
8. Mackenzie and Vernon, J. Entomol. Soc. B.C. 84:9:1987

WIREWORMS

Wireworms

Chemical Control -

	Rate (kg AI/ha)	Crop	References
Fonofos	2.3 (in-furrow)	potato	1,2,4
	5.6 (broadcast)	potato	2,4
Terbufos	75 g/100 m	corn	3,5,6

Broadcast application, apply immediately before seeding, and harrow, disc or roto-till into top 12 cm of soil.

Restrictions -

Fonofos:	Use 10% granular for in-furrow treatment at time of seeding. Use only on irrigated soils.
Terbufos:	Apply in-furrow to crops with minimum 75 cm row spacing.

References -

1. Burrage, Pest. Res. Rep. 1969:127.
2. Lilly, J. Econ. Entomol. 66:1205,1973.
3. Wilkinson et al., J. Entomol. Soc. B.C. 73:3,1976.
4. Wilkinson et al., J. Entomol. Soc. B.C. 75:3,1978.
5. Wilkinson, Pest. Res. Rep. 1974:188.
6. Wilkinson, Pest. Res. Rep. 1975:111.

GREENHOUSE CROPS

M. Steiner and J. McCullough

The following use patterns are in accordance with labels on commercial and restricted class products registered for use in commercial greenhouses. For additional use patterns refer to section on domestic class products for interior plantscapes and houseplants.

It is important to alternate between chemical families to delay resistance build-up in problem pests.

All chemicals may be phytotoxic to some plants or plant stages or under certain conditions. Consult label for additional information or refer to Alberta Agriculture Garden Fax Leaflet 270/621-1 "Susceptibility of Some Ornamental Plants to Pesticide Injury".

ORNAMENTAL CROPS

APHIDS

Aphids

Chemical	Rate (AI)	Crop(s)
Aldicarb	60-125 g/100 m^2	Chrysanthemum
Diazinon	50-75 g/100 L	Chrysanthemum Carnation, Rose
Dichlorvos	1 can/300 m^3 as a smoke 3.5 g/100 m^3 as a fog	Ornamentals
Endosulfan	50 g/100 L	Ornamentals
Lindane	25 g/100 L or 1 pellet for 255 m^3 as a smoke 0.7 g/100 m^3 as a fog	Ornamentals
Malathion	65-125 g/100 L	Ornamentals
Naled	8.6 g/100 m^3 vaporized from heating pipes	Ornamentals
Nicotine sulfate	1 can/300 m^3 vaporized as a smoke	Ornamentals

Chemical	Rate (AI)	Crop(s)
Oxydemeton-methyl	45-90 g/100 L	Ornamentals
Parathion	1 can/300 m^3 as a smoke	Ornamentals
Pirimicarb	25 g/100 L	Ornamentals
Soap	1 kg/100 L	Ornamentals
Sulfotep	1 can/300 m^3 as a smoke 1.7 g/100 m^3 as a fog	Ornamentals

Restrictions -

Aldicarb: Do not work treated area within 48 hours of applying. Do not market potted plants within 4 weeks of last application. Do not plant food crops in soil previously treated with aldicarb for at least 1 year.

Smokes, fogs, and other fumigants: Special protective equipment required and thorough ventilation of house after exposure period. Water plants well, but ensure that blossoms and foliage are dry before applying treatment.

BLACK VINE WEEVIL

Black vine weevil

Chemical	Rate (AI)	Crop(s)
Endosulfan	50 g/100 L	Ornamentals
Heterorhabditis heliothidis (nematode)	5,000 nematodes/L soil	Woody Ornamentals
Methoxychlor	30 g/100 L	Ornamentals

CATERPILLARS

Caterpillars

Chemical	Rate (AI)	Crop(s)
Acephate	64 g/100 L	Rose
Bacillus thuringiensis	Follow label	Chrysanthemum, Rose
Diazinon	50-75 g/100 L	Chrysanthemum, Carnation
Dichlorvos	1 can/300 m^3 as a smoke 3.5 g/100 m^3 as a fog	Ornamentals
Endosulfan	50 g/100 L	Ornamentals
Naled	8.6 g/100 m^3 vaporized from heating pipes	Ornamentals
Parathion	1 can/300 m^3 as a smoke	Ornamentals

Restrictions -

Smokes, fogs and other fumigants: Special protective equipment required and thorough ventilation of house after exposure period. Water plants well, but ensure that blossoms and foliage are dry before applying treatment.

CYCLAMEN MITE

Cyclamen mite

Chemical	Rate (AI)	Crop(s)
Dicofol	23-47 g/100 L	Ornamentals
Endosulfan	50 g/100 L	Ornamentals

FUNGUS GNATS

Fungus gnats

Chemical	Rate (AI)	Crop(s)
Bendiocarb	100 g/100 L	Ornamentals
Malathion	50 g/100 L	Ornamentals

GREENHOUSE WHITEFLY

Greenhouse whitefly

Chemical	Rate (AI)	Crop(s)
Aldicarb	60-125 g/100 m^2	Chrysanthemum, Poinsettia
Chlorpyrifos	37 g/100 L	Ornamentals
Dichlorvos	1 can/300 m^3 as a smoke 3.5 g/100 m^3 as a fog	Ornamentals
Endosulfan	50 g/100 L	Ornamentals
Lindane	25 g/100 L or 1 pellet /255 m^3 as a smoke	Ornamentals
Malathion	65-125 g/100 L	Ornamentals
Naled	8.6 g/100 m^3 vaporized from heating pipes	Ornamentals
Parathion	1 can/300 m^3 as a smoke	Ornamentals
Permethrin	10 g/100 L	Aspidistra, Begonia, Boston fern, Chrysanthemum, Cordyline, Dieffenbachia, Dracaena, Ficus, Fuchsia, Geranium, Gerbera, Impatiens,

Chemical	Rate (AI)	Crop(s)
		Petunia, Philodendron, Poinsettia, Rose, Sansevieria, Spider plant
Resmethrin	0.29% ready to use concentrate	African violet, Azalea, Chrysanthemum, Cineraria, Dieffenbachia, Fuchsia, Gloxinia, Ivy, Jerusalem cherry, Lantana, Neanthebella palm, Petunia, Rose, Snapdragon
Soap	1 kg/100 L	Ornamentals
Sulfotep	1 can/300 m^3 as a smoke 1.7 g/100 m^3 as a fog	Ornamentals

Restrictions -

Aldicarb: Do not work treated area within 48 hours of applying. Do not market potted plants within 4 weeks of last application. Do not plant food crops in soil previously treated with aldicarb for at least 1 year.

Smokes, fogs, and other fumigants: Special protective equipment required and thorough ventilation of house after exposure period. Water plants well, but ensure blossoms and foliage are dry before applying treatment.

LEAFMINERS

Leafminers

Chemical	Rate (AI)	Crop(s)
Larvae		
Acephate	64 g/100 L	Rose
Aldicarb	60-125 g/100 m^2	Chrysanthemum
Pyrazophos	45 g/100 L	Chrysanthemum
Adults		
Diazinon	50 g/100 L	Azalea, Carnation, Chrysanthemum
Dichlorvos	3.5 g/100 m^3 as a fog	Chrysanthemum
Malathion	65-125 g/100 L	Ornamentals
Permethrin	10 g/100 L	Chrysanthemum

Restrictions -
Aldicarb: Do not work treated area within 48 hours of applying. Do not market potted plants within 4 weeks of last application. Do not plant food crops in soil previously treated with aldicarb for at least 1 year.

LYGUS BUGS

Lygus bug

Chemical	Rate (AI)	Crop(s)
Malathion	65-125 g/100 L	Ornamentals
Parathion	1 can/300 m^3 as a smoke	Ornamentals

Restrictions -
Parathion: Special protective equipment required and thorough ventilation of house after exposure period. Water plants well, but ensure that blossoms and foliage are dry before applying treatment.

MEALYBUG

Mealybug

Chemical	Rate (AI)	Crop(s)
Chlorpyrifos	96 g/100 L	Ornamentals
Dichlorvos	1 can/300 m^3 as a smoke 3.5 g/100 m^3 as a fog	Ornamentals
Malathion	65-125 g/100 L	Ornamentals
Naled	8.6 g/100 m^3 vaporized from heating pipes	Ornamentals
Parathion	1 can/300 m^3 as a smoke	Ornamentals
Soap	1 kg/100 L	Ornamentals
Sulfotep	1 can/300 m^3 as a smoke 1.7 g/100 m^3 as a fog	Ornamentals

Restrictions -

Smokes, fogs, and other fumigants: Special protective equipment required and thorough ventilation of house after exposure period. Water plants well, but ensure that blossoms and foliage are dry before applying treatment.

SCALES

Scales

Chemical	Rate (AI)	Crop(s)
Acephate	64 g/100 L	Rose
Bendiocarb	60 g/100 L	Ornamentals
Chlorpyrifos	91 g/100 L	Ornamentals
Soap	1 kg/100 L	Ornamentals
Sulfotep	1 can/300 m^3 as a smoke 1.7 g/100 m^3 as a fog	Ornamentals

Restrictions -

Sulfotep:	Special protective equipment required and thorough ventilation of house after exposure period. Water plants well, but ensure that blossoms and foliage are dry before applying treatment.
Bendiocarb:	Preharvest interval 14 days; re-entry period 24 hours.

SLUGS, SNAILS

Slugs and Snails

Chemical	Rate (AI)	Crop(s)
Methiocarb	10 g/100 m^2 as a scatter bait	Ornamentals

THRIPS

Thrips

Chemical	Rate (AI)	Crop(s)	References
Bendiocarb	60-80 g/100 L	Ornamentals	
Chlorpyrifos	24 g/100 L	Ornamentals	
Deltamethrin	1.75-2.5 g/100 L	Chrysanthemum, Cineraria, Easter Lily, Geranium	1
Diazinon	50-75 g/100 L as a foliar spray or a soil surface spray	Chrysanthemum, Carnation, Rose	
Dichlorvos	1 can/300 m^3 as a smoke or	Ornamentals	
	3.5 g/100 m^3 as a fog	Ornamentals	
Lindane	1 pellet/255 m^3 as a smoke or 25 g/100 L	Ornamentals	

Chemical	Rate (AI)	Crop(s)	References
Malathion	65-125 g/100 L	Ornamentals	
Nicotine	1 can/300 m^3 as a smoke	Ornamentals	
Parathion	1 can/300 m^3 as a smoke	Ornamentals	

Restrictions -

Smokes, fogs and other fumigants: Special protective equipment required and thorough ventilation of house after exposure period. Water plants well, but ensure that blossoms and foliage are dry before applying treatment.

Deltamethrin: Do not apply within 7 days of crop harvest. Do not use with fogging machines.

Bendiocarb: Preharvest interval 14 days, re-entry period 24 hours.

References -

1. Steiner, Pest Res. Rep. 1985:206.

TWO-SPOTTED SPIDER MITE

Two-spotted spider mite

Chemical	Rate (AI)	Crop(s)
Aldicarb	60-125 g/100 m^2	Chrysanthemum, Poinsettia
Dichlorvos	1 can/300 m^3 as a smoke 3.5 g/100 m^3 as a fog	Ornamentals
Dicofol	23-47 g/100 L	Ornamentals
Dienochlor	30 g/100 L	Azalea, Begonia, Carnation, Chrysanthemum, Delphinium, Cardenia, Poinsettia, Rose, Snapdragon, Zinnia
Fenbutatin-oxide	25-50 g/100 L	Ornamentals

Chemical	Rate (AI)	Crop(s)
Malathion	7-14 g/100 m^2	Ornamentals
Naled	8.6 g/100 m^3 vaporized from heating pipes	Ornamentals
Oxydemeton-methyl	45-90 g/100 L	Ornamentals
Parathion	1 can/300 m^3 as a smoke	Ornamentals
Soap	1 kg/100 L	Ornamentals
Sulfotep	1 can/300 m^3 as a smoke 1.7 g/100 m^3 as a fog	Ornamentals
Tetradifon	1 can/300 m^3 as a smoke	Ornamentals

Restrictions -

Aldicarb: Do not work treated area within 48 hours of applying. Do not market potted plants within 4 weeks of last application. Do not plant food crops in soil previously treated with aldicarb for at least 1 year.

Smokes, fogs, and other fumigants: Special protective equipment required and thorough ventilation of house after exposure period. Water plants well, but ensure that blossoms and foliage are dry before applying treatment.

GREENHOUSE VEGETABLE CROPS

M. Steiner & J. McCullough

Wait period before harvest in parenthesis (days).

APHIDS

Aphids

Chemical	Rate (AI)	Crop(s)	References
Diazinon	50-75 g/100 L	Tomato (8)	
Dichlorvos	3.5 g/100 m^3 as a fog	Cucumber (7) Tomato (7)	
Endosulfan	50 g/100 L	Tomato (2) Cucumber (2)	

Chemical	Rate (AI)	Crop(s)	References
Malathion	7-14 g/100 m^2 or	Lettuce heads (7)	
	65-125 g/100 L	Lettuce leaf (21)	
Naled	8.6 g/100 m^3 vaporized from heating pipes	Cucumber (1) Tomato (1)	
Nicotine	1 can/300 m^3 as a smoke	Cucumber (3) Lettuce (7) Tomato (3)	
Parathion	1 can/300 m^3 as a smoke	Cucumber (1) Tomato (1)	
Soap	1 kg/100 L	Vegetables (0) Peppers (5)	

Restrictions -

Smokes, fogs and other fumigants: Special protective equipment required and thorough ventilation of house after exposure period. Water plants well, but ensure that blossoms and foliage are dry before applying treatment.

Naled: Some phytotoxicity reported to flowers of cucumber and tomato.

CATERPILLARS

Caterpillars

Chemical	Rate (AI)	Crop(s)	References
Bacillus thuringiensis	Follow label	Tomato (0) Peppers (0)	
Naled	8.6 g/100 m^3 vaporized from heating pipes	Cucumber (1) Tomato (1)	
Parathion	1 can/300 m^3 as a smoke	Cucumber (1) Tomato (1)	

Restrictions -

Smokes, fogs, and other fumigants: Special protective equipment required and thorough ventilation of house after exposure period. Water plants well, but ensure that blossoms and foliage are dry before applying treatment.

GREENHOUSE WHITEFLY

Greenhouse whitefly

For integrated control with biological agents, see page 8 - 15.

Chemical	Rate (AI)	Crop(s)	References
Dichlorvos	3.5 g/100 m^3 as a fog	Cucumber (7) Tomato (7)	
Endosulfan	50 g/100 L	Cucumber (2) Tomato (2)	
Naled	8.6 g/100 m^3 vaporized from heating pipes	Cucumber (1) Tomato (1)	
Parathion	1 can/300 m^3 as a smoke	Cucumber (1) Tomato (1)	
Permethrin	10 g/100 L	Cucumber (1) Tomato (1)	
Plant Products Dormant Oil	1 L/100 L	Cucumber (3)	
Soap	1 kg/100 L	Vegetables (0)	

****Caution**** -

Plant Products Dormant Oil - May be phytotoxic at higher than recommended concentrations, or to younger leaves at temperatures of 25°C or higher. Do not use within 30 days of application of sulphur containing materials.

Restrictions -

Smokes, fogs, and other fumigants: Special protective equipment required and thorough ventilation of house after exposure period. Water plants well, but ensure that blossoms and foliage are dry before applying treatment.

References -

1. Steiner, Pest. Res. Rep. 1985, p. 196,197.

LEAFMINERS

Leafminers

Chemical	Rate (AI)	Crop(s)	References
Diazinon	5.5-10 g/100 m^2	Tomato (8)	
Malathion	7-14 g/100 m^2	Tomato (3)	

THRIPS

Thrips

Chemical	Rate (AI)	Crop(s)	References
*Diazinon	11 g/100 m^2 as a soil surface treatment	Cucumber (1)	
Dichlorvos	3.5 g/100 m^3 as a fog	Cucumber (7) Tomato (7)	
Methomyl	4.75 g/100 L	Cucumber (3)	1
*Nicotine sulfate	1 can/300 m^3 as a smoke	Cucumber (3) Tomato (3) Lettuce (7)	
*Parathion	1 can/300 m^3 as a smoke	Cucumber (1) Tomato (1)	

Restrictions -

Smokes, fogs, and other fumigants: Special protective equipment required and thorough ventilation of house after exposure period. Water plants well, but ensure that blossoms and foliage are dry before applying treatment.

*Note: Not very effective against western flower thrips.

References -

1. Steiner, Personal Communication.

TWO-SPOTTED SPIDER MITE

Two-spotted spider mite

For integrated control with biological agents, see page 8 - 15.

Chemical	Rate (AI)	Crop(s)
Fenbutatin-oxide	25-50 g/100 L	Cucumber (3) Tomato (5)
Malathion	7-14 g/100 m^2	Lettuce leaf (21) Lettuce head (7) Tomato (3)
Naled	8.6 g/100 m^3 vaporized from heating pipes	Cucumber (1) Tomato (1)
Parathion	1 can/300 m^3 as a smoke	Cucumber (1) Tomato (1)
Soap	1 kg/100 L	Vegetables (0)
Tetradifon	1 can/300 m^3 as a smoke	Cucumber (1)

Restrictions -

Smokes, fogs, and other fumigants: Special protective equipment required and thorough ventilation of house after exposure period. Water plants well, but ensure that blossoms and foliage are dry before applying treatment.

References -

1. Pesticide Recommendations for Greenhouse Ornamentals. Ont. Min. Agric. Food, Pub. 381, 1985.
2. B.C. Dept. Agric. Nursery, Greenhouse Vegetable nad Ornamental Guide 1988/89.
3. Compendium of Pest Control Products Registered in Canada 1989 (microfiche).

INTEGRATED CONTROL OF TWO-SPOTTED SPIDER MITE AND GREENHOUSE WHITEFLY ON GREENHOUSE TOMATOES AND CUCUMBERS

Whiteflies and two-spotted spider mites on greenhouse tomatoes and cucumbers can be controlled by parasites and predators in conjunction with chemical insecticides. Chemicals and application methods for these and other pests should be selected to present minimal hazard to the biological agents. Heavily pest-infested areas may require spot treatment but overall sprays should be avoided. The biological agents should be introduced at the first sign of mites or whiteflies or as soon as the crop goes in if previous crops were infested. Introductions onto other than very low initial pest infestations have no chance for successful control.

Whitefly Control

At first signs of whitefly on yellow sticky strips, introduce the parasitic wasp *Encarsia formosa* at a rate of 1 per 4 plants for tomatoes and 1 per 2 plants for cucumbers. Repeat weekly for 9 weeks or until 80% of all whitefly scales turn black.

Spider Control

Introduce the predatory mite *Phytoseiulus persimilis* at the rate of 1 per plant. Repeat at weekly intervals until established in the crop.

THE EFFECT OF GREENHOUSE PESTICIDES ON BIOLOGICAL CONTROL AGENTS

Pesticide	Application	Effect on E. formosa	Effect on P.persimilis	Effect on A.cucumeris
Ambush	spray	harmful (36)	harmful (30)	harmful (30)
Benomyl	spray	negligible	harmful	harmful
Botran	spray	negligible	negligible	negligible
Bravo	spray	negligible	negligible	negligible
Captan	spray	negligible	negligible	harmful (7)
Diazinon	soil drench	harmful (14)	negligible	harmful (7)
Dibrom	fumigant	harmful (7)	harmful (7)	harmful (7)
Dichlorvos	fumigant	harmful (2)	harmful (2)	harmful (2)
Dipel	spray	negligible	negligible	negligible
Insecticidal soap	spray	harmful (adults)	harmful (0)	harmful (0)
Kelthane	spray	harmful (14)	harmful (4)	harmful (4)
Lannate	spray	harmful (31)	harmful (14)	harmful (30)
Lindane	spray	harmful (14)	harmful (7)	harmful (20)
Malathion	spray	harmful (14)	harmful (14)	harmful (14)
Mancozeb	spray	negligible	negligible	harmful
Maneb	spray	negligible	negligible	negligible
Microniasul	spray	negligible	negligible	negligible
Nicotine	fumigant	harmful	negligible	negligible
Parathion	fumigant	harmful (14)	harmful (7)	harmful (7)
Petroleum oil	spray	harmful (0)	harmful (0)	harmful (0)
Rovral	spray	negligible	harmful (7)	harmful
Sevin	spray	harmful (14)	harmful (7)	harmful (7)
Sulphur	dust	negligible	negligible	harmful
Sulphur	fumigant	negligible	negligible	negligible
Tedion	fumigant	negligible	negligible	negligible
Thiodan	spray	harmful (20)	harmful (7)	harmful (7)
Thiodan	drench	harmful (2)	negligible	harmful (2)
Vendex	spray	negligible	negligible	negligible

() Residual toxicity to bio-control agent in days at 20°C e.g. Insecticidal soap is listed as "harmful, adults (0)", so sprays of this pesticide will only kill adult stages of predators and parasites. It has "0" days residual toxicity so bio-controls could be re-introduced the same day without harm.

References -

1. B.C. Dept. Agric. Nursery, Greenhouse Vegetable and Ornamental Production Guide 1988/89.
2. Steiner and Elliott, Biological Pest Management for Interior Plantscapes, AEC, Vegreville 1987.

INTERIOR PLANTSCAPES AND HOUSE PLANTS

M. Steiner and J. McCullough

The following use patterns are in accordance with labels on domestic class products registered for use on house plants and in interior plantscapes for ornamentals. Rates are given in terms of commonly available formulated products.

All chemicals may be phytotoxic to some plants or plant stages or under certain conditions. Consult label for additional information or refer to Alberta Agriculture Garden Fax leaflet 270/621-1 "Susceptibility of Some Ornamental Plants to Pesticide Injury". If in doubt, spray a small area first and wait 4-5 days for signs of injury. Move plants outdoors to treat where practical.

For larger greenhouses and atriums, biological pest control may be a practical alternative. See references page 9 - 8.

APHIDS

Aphids

Cultural Control -
Use yellow sticky traps in greenhouses to catch incoming winged aphids. Screen windows and vents to exclude them. Prune off heavily infested growth.

Chemical Control -

Product	Rate	Comments
Soap 2% solution	Ready to use	Ensure thorough coverage. Repeat as necessary.
Soap 50.5% solution	20 ml/L	Ensure thorough coverage. Repeat as necessary.
Malathion 50% EC	1-2 ml/L	Repeat at 7-14 day intervals as necessary.
Resmethrin 1% Solution	Ready to use	Spray foliage, repeat as necessary.
Resmethrin 0.25%	Ready to use aerosol	Spray at minimum 50 cm distance from foliage. Repeat as necessary.

Product	Rate	Comments
Resmethrin 0.2% + allethrin 0.125% aerosol	Ready to use	Spray at minimum 50 cm cm distance from foliage. Repeat as necessary.
Resmethrin 0.25% + tetramethrin 0.25% aerosol	Ready to use	Spray at minimum 50 cm distance from foliage Repeat as necessary.

CYCLAMEN MITES

Cyclamen mite

Cultural Control -

This mite likes high humidity. Move infested plants to drier cooler area.

Chemical Control -

Product	Rate	Comments
Dicofol 18.5% EC	2 ml/L	Ensure thorough coverage, particularly of new growth.
Dicofol 0.46%	Ready to use	Ensure thorough coverage, particularly of new growth.
Dicofol 3.9% EC	5 ml/L	For African violets.
Resmethrin 0.25% + tetramethrin 0.25% aerosol	Ready to use	Spray at minimum 50 cm distance. Repeat as necessary.

Restrictions -

Dicofol 18.5% EC: Greenhouse registration only.

FUNGUS GNATS

Fungus gnats

Cultural Control -

Wet soil high in organic matter favours fungus gnats. Allow soil to dry between watering. Remove rotting leaves and roots and repot if necessary in sterilized soil. A thin layer of sand or pebbles on the soil surface will discourage them.

Chemical Control -

Product	Rate	Comments
Chlorpyrifos 0.5% dust	Ready to use	Dust on soil surface for larvae.
Diazinon 2% dust	Ready to use	Dust on soil surface for larvae. Work into top 3-5 cm and water in thoroughly.
Pyrethrins 0.25%	Ready to use	Mist around foliage and use as a space spray for adults.

Restrictions -

Chlorpyrifos: If possible, remove plants outside for treatment. Do not repeat more than once every two months.

MEALYBUGS

Mealybugs

Cultural Control -

Prune off heavily infested foliage. Mist plants frequently. Remove large mealybugs before they lay white fluffy egg masses. Check roots if infestation persists.

Chemical Control -

Product	Rate	Comments
Chlorpyrifos 0.5% dust	Ready to use	Dust foliage and soil surface.
Soap 2% solution	Ready to use	Ensure thorough coverage. Repeat as necessary.
Soap 50.5% solution	20 ml/L	Ensure thorough coverage. Repeat as necessary.

Malathion 50% EC	2 ml/L	Spray foliage. Repeat at 7-14 day intervals as necessary.
n-propanol or rubbing alcohol	Ready to use	Dab on insects, avoiding contact with plants.

Restrictions -

Chlorpyrifos: If possible, remove plants outside for treatment. Do not repeat more than once every two months.

MILLIPEDES

Millipeds

Cultural Control -

Repot in sterilized potting soil after washing off roots. In greenhouses, clean up benches and floor areas.

Chemical Control -

Product	Rate	Comments
Chlorpyrifos 0.5% dust	Ready to use	Dust soil surface and water in.
Diazinon 2% dust	Ready to use	Dust soil surface, mix into top 3-5 cm and water thoroughly.

Restrictions -

Chlorpyrifos: If possible, remove plants outside for treatment. Do not repeat more than once every two months.

SCALES

Scales

Cultural Control -

Prune off heavily infested foliage. Hand pick large scales. Mist foliage frequently.

Chemical Control -

Product	Rate	Comments
Chlorpyrifos 0.5% dust	Ready to use	Dust foliage.

Product	Rate	Comments
Soap 2% solution	Ready to use	Ensure thorough coverage. Repeat as necessary.
Soap 50.5% solution	20 ml/L	Ensure thorough coverage. Repeat as necessary.
Malathion 50% EC	1-2 ml/L	Spray foliage. Repeat at 7-14 day intervals as necessary.

Restrictions -

Chlorpyrifos: If possible, remove plants outside for treatment. Do not repeat more than once every two months.

SLUGS AND SNAILS

Slugs and Snails

Cultural Control -

Remove debris, weeds, boards, etc. from greenhouse floors and benches. Keep floor dry.

Chemical Control -

Product	Rate	Comments
Metaldehyde 6.5% bait	Ready to use	Wet soil down first. Scatter or place in piles. Use fresh bait.
Methiocarb 2% bait	Ready to use	Scatter bait evenly.

Restrictions -

Metaldehyde, methiocarb: Greenhouse registration only. Keep pets away.

SPIDER MITES

Spider mites

Cultural Control -
Mist underside of leaves frequently and avoid hot dry areas.

Chemical Control -

Product	Rate	Comments
Dicofol 18.5% EC	2 ml/L	Ensure thorough coverage of underside of leaves. Repeat at 7-14 days as necessary.
Dicofol 0.46% EC	Ready to use	Ensure thorough coverage of underside of leaves. Repeat at 7-14 days as necessary.
Soap	Ready to use	Ensure thorough coverage of underside of leaves. Repeat as necessary.
Soap 50.5% solution	20 ml/L	Ensure thorough coverage of underside of leaves. Repeat as necessary.
Malathion 50% EC	1-2 ml/L	Ensure thorough coverage of underside of leaves. Repeat at 7-14 day intervals as necessary.

Restrictions -
Dicofol 18.5% EC: Greenhouse registration only.

SPRINGTAILS

Springtails

Cultural Control -
Allow soil to dry between watering. Most species are harmless and do not require control.

Chemical Control -

Product	Rate	Comments
Diazinon 2% dust	Ready to use	Dust soil surface. Work into top 3-5 cm and water in thoroughly.

THRIPS

Thrips

Cultural Control -

Increase humidity and avoid high temperatures. Mist plants frequently. Keep cut garden flowers away from house plants as they are frequently infested.

Chemical Control -

Product	Rate	Comments
Chlorpyrifos 0.5% dust	Ready to use	Dust foliage and soil surface.
Malathion 50% EC	1-2 ml/L	Spray foliage, particularly growing tips. Repeat at 7-14 day intervals as necessary.
Pyrethrins 0.25% aerosol	Ready to use	Spray at minimum 50 cm distance from foliage. Repeat as necessary.
Resmethrin 1% solution	Ready to use	Spray foliage. Repeat as necessary.

Restrictions -

Chlorpyrifos: If possible, remove plants outside for treatment. Do not repeat more than once every two months.

WHITEFLIES

Whiteflies

Cultural Control -

Hang yellow sticky traps in greenhouses to trap adults.

Chemical Control -

Product	Rate	Comments
Chlorpyrifos 0.5% dust	Ready to use	Dust underside of leaves.
Soap 2% solution	Ready to use	Ensure thorough coverage of underside of leaves.
Soap 50.5% solution	20 ml/L	Ensure thorough coverage of underside of leaves.
Malathion 50% EC	1-2 ml/L	Spray foliage. Repeat at 7-14 day intervals as necessary.
Pyrethrins 0.25% aerosol	Ready to use	Spray at minimum distance of 50 cm from foliage. Repeat as necessary (adults only).
Resmethrin 1% solution	Ready to use	Spray at minimum distance of 50 cm from foliage. Repeat as necessary (adults only).
Resmethrin 0.25%	Ready to use	Spray at minimum aerosol distance of 50 cm from foliage. Repeat as necessary (adults only).
Resmethrin 0.25% + tetramethrin 0.25% aerosol	Ready to use	Spray at minimum distance of 50 cm from foliage. Repeat as necessary (adults only).

Restrictions -

Chlorpyrifos: If possible, remove plants outside for treatment. Do not repeat more than once every two months.

References -

1. Compendium of Pest Control Products Registered in Canada 1989. (Microfiche)

2. Alberta Agriculture Garden Fax Leaflet 270/621-1 "Susceptibility of Some Ornamental Plants to Pesticide Injury".
3. Pest Problems in Small Greenhouses and Indoor Plantings, Province of British Columbia. 1982.
4. Steiner and Elliott, "Biological Pest Management for Interior Plantscapes", Alberta Environment Centre, Vegreville, Alberta. 1987.

MUSHROOMS

R.S. Vernon

MUSHROOM FLIES - SCIARID, PHORID & CECID FLIES

Mushroom flies

Chemical Control - (Loading to Cool-Down)

	Rate (g AI/100 m^2)
*Diazinon	25-50
*Dimethoate	30

*Apply in 5L H_2O/100 m^2 to interior walls and floor. If ceiling is sprayed, protect top beds with polyethylene film. Do not spray compost. Brush on support posts and side boards.

In addition to the above, use one of the following as a fog:

	Rate (g AI/100 m^3)
*Dichlorvos	1
*Pyrethrin	.58

*Do not fog directly on beds. Ventilate after 1 hour exposure.

Chemical Control - (Spawning through Casing)

	Rate (g AI/100 m^2)
*Diazinon	25-50

*Apply in 5L H_2O/100 m^2 to walls, ceiling, floor, support posts, and outsides of bed boards immediately after spawning. Protect compost beds with polyethylene film. Repeat immediately after casing but do not spray ceiling, support posts, or bed boards. Brush on support posts and bed boards. Do not spray compost or casing soil.

In addition to the above, use one of the following as a fog:

	Rate (g AI/100 m^2)
*Dichlorvos	1
*Pyrethrin	.58

*Dichlorvos: Do not apply later than 1 day after casing. Ventilate after 1 hour exposure. Do not fog directly on beds.

*Pyrethrin: Apply twice weekly or as required. Ventilate after 1 hour exposure. Do not fog directly on beds.

and one of the following: -

	Rate (g AI/100 m^2)
*Malathion (dust)	12-15
*Malathion (WP)	12.5-18.7
*Pyrethrin (dust)	.09
+Methoprene (EC)	105

*To obtain good control, even coverage is essential. Apply twice weekly or as required.

+Incorporate in casing at time of casing. Make application evenly and mechanically mix into casing material prior to casing operation; or drench evenly onto the surface of the casing immediately after placement.

Chemical Control - (Production)

	Rate (g AI/100 m^2)
*Malathion	12-15
+Malathion	12.5-18.7
++Pyrethrin	.09

*To obtain good control, even coverage is essential. Apply before or after flush, twice weekly, or as required. Do not apply within 2 days of harvest.

+Spray bed surface. Apply before first pinning and between breaks. Apply twice weekly or as required. Do not apply within 2 days of harvest.

++To obtain good control, ensure even coverage. Apply every 3 days or as required. Do not apply within 1 day of harvest.

In addition to the above, use the following as a fog:

	Rate (g AI/100 m^3)
*Pyrethrin	.58

*Apply twice weekly or as required. Ventilate after 1 hour exposure. Do not fog directly on beds. Do not apply within 1 day of harvest.

MITES

Mites

Chemical Control -

	Rate (g AI/100 m^3)
*Malathion (WP)	12.5-18.7

Spray bed surface. Apply as required but not within 2 days of harvest.

BERRY CROPS

M.S. Okuda and R.S. Vernon

Caution: Most insecticides are toxic to bees. See page 16 - 1 "Insecticide Use and Bee Safety" before spraying berry crops.

APHIDS

Aphids

Chemical Control -

	Rate	Preharvest Interval	References
Malathion 50% EC ...	1.6 mL/L	3	-
Rotenone...........	1% dust	-	-
Oxydemeton - methyl 24% SC	2.33 L/ha	40	1

Restrictions -
Malathion: Do not apply at air temperatures below 20°C.

References -
1. Raworth and Clements, Agric. Can., 1988

CHOKECHERRY FRUIT INSECTS

Chokecherry fruit insects

Chemical Control -

	Rate	Preharvest Interval	References
Trichlorfon 4 EC	25 mL/ 100 L	-	1

Apply insecticides between start and completion of petal fall. Controls both midge and sawfly. Apply spray when most petals have fallen.

See Appendix I re other insecticides tested for control of fruit insects.

References -

1. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-81, 1974; NOR-X-150,1976; NOR-X-184,1977; NOR-X-213, 1979; NOR-X-227,1980.

CURRANT FRUIT FLY (currant and gooseberry)

Currant fruit fly

Chemical Control -

	Rate	Preharvest Interval	References
Malathion 50% EC	1.6 mL/L	3	1,2
Methoxychlor 25% EC .	7.8 mL/L	14	1

Apply spray when most of petals have fallen and repeat in 10 days.

Restrictions -
Malathion: Do not apply at air temperatures below 20°C.

References -

1. Richardson and Andison, Agric. Can., Pub. 1143,1967.
2. B.C. Dept. Agric., Pub. 74-75,1974.
3. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-227, 1980.

LEAFROLLERS (strawberry and raspberry)

Leafrollers (strawberry & raspberry)

Chemical Control -

	Rate	Preharvest Interval	References
Malathion 50% EC	1.6 mL/L	3	1

Apply spray at first sign of damage and repeat as necessary.

Restrictions -
Malathion: Do not apply at air temperatures below 20° C.

References -

1. B.C. Dept. Agric., Pub. 74-75, 1974.

MITES (raspberry and other fruits)

Mites

Chemical Control -

	Rate	Preharvest Interval	References
Cyhexatin (strawberries).......	75-100 mL /100 L	see label	3
Dicofol 18.5% EC	1.6 mL/L	see label	1,2
Malathion 50% EC	1.6 mL/L	see label	
Tetradifon 10% EC ...	1.6 mL/L	see label	1
Fenbutatin-oxide 50 WP	25 mL/ 100 L	see label	3

Restrictions -

Observe the wait period shown on the label for the specific crop.
Malathion: Do not apply at air temperatures below 20°C.

References -

1. Agric. Can., Pub. 880, 1964.
2. B.C. Dept. Agric., Pub. 74-75, 1974.
3. Pest. Res. Rep. 1975; 1976; 1977.

RASPBERRY CROWN BORER

Raspberry crown borer

Chemical Control -

	Rate	Preharvest Interval	References
*Azinphos-methyl	1125-2250 mL AI/725 L/ha	-	-
Diazinon 12.5% EC ..	7.8 mL/L	N/A	1,2

*Commercial applications only.

Azinphos-methyl:	Apply to lower portion of canes and crowns using 1800 L water/ha. Rates up to 1.1 kg/ha may be applied within 3 days of harvest. Rates over 1.1 kg/ha should be applied only before fruit set or after harvest.
Diazinon:	Apply as a drench to the crown area using 0.6 L of mixture, plant in October or in early spring when new shoots are about 10 cm high.

References -

1. B.C. Dept. Agric. Pub. 74-75,1974.
2. Raine, Agric. Can., Pub. 1268,1966.

RASPBERRY FRUIT WORM

Raspberry fruit worm

Chemical Control -

	Rate	Preharvest Interval	References
Rotenone 40% WP	25 g/5 l	N/A	1

Apply when berries start to form.

References -

1. Manitoba Dept. Agric. Pub. 74-75, 1974.

RASPBERRY SAWFLY, IMPORTED CURRANTWORM

Raspberry sawfly, Imported currantworm

Chemical Control -

	Rate	Preharvest Interval	References
Diazinon 12.5% EC	7.8 mL/L	Prebloom	1
Rotenone	1% dust	-	-

References -

1. B.C. Dept. Agric., Pub. 74-75, 1974.

STRAWBERRY CUTWORM (commercial strawberries)

Strawberry cutworm (commercial strawberries)

Cultural Control -
Do not disc-in old stands until after 1 September.

Chemical Control -

	Rate (g AI/ha)	References
Chlorpyrifos	550	1,2

Apply in 2000 L/ha as a band treatment between 1-15 June.

References -
1. Askew et al., Pest. Res. Rep. 1978:68.
2. Ayre, Agric. Can., Winnipeg. In press.

STRAWBERRY ROOT WEEVIL (strawberries)

Strawberry root weevil

Chemical control -

Adult Control	Rate	Preharvest Interval	References
Malathion 50 EC .	7.8-11.7 mL/L	Prefruiting	1,2

Use the lower rate in spring when fresh leaf notching seen. The higher rate may be used after fruit is harvested.

Restrictions -
Malathion: Do not apply at air temperatures below 20°C.

References -
1. B.C. Dept. Agric., Berry Prod. Rec. 1970.
2. Compendium on Reg. Uses of Pesticides.

SHELTERBELTS, ORNAMENTAL TREES AND SHRUBS

G.B. Neill and H.F. Cerezke

The establishment of economic threshold guidelines for control of insect and mite pests of shelterbelts, ornamental trees, and shrubs is highly subjective but can be defined in general terms on the basis of number of insects required to effect mortality of the host plant or on numbers of insects required to inflict a specified level of visual damage. Single plantings of trees and shrubs in the landscape are grown mainly for their aesthetic value where severe weakening or mortality cannot be tolerated, while aesthetic appearance of shelterbelts is likely to be of secondary value. As a starting point, therefore, it seems reasonable to restrict economic thresholds at this time to single plantings and to base the tolerance limits on numbers of insects likely to cause a degree of damage that is easily visible. Since published data on this aspect are rare, some arbitrary thresholds are presented below for a few insect examples to serve as a rough guideline. At these suggested levels, insecticidal treatment may be applied to prevent the development of damage or to safeguard against further buildup and spread of the insect concerned.

Ornamental trees, shrubs, and shelterbelts are frequently adjacent to fruit and vegetable gardens, field crops, pastures, and open water. Therefore, care must be exercised when spraying with all chemical insecticides to reduce or prevent contamination by spray drift.

The following recommendations with designated dosages are given as *active ingredient* and using high-pressure spray equipment unless otherwise specified. *Follow label instructions explicitly for correct dosage, coverage, timing of spray, and to avoid phytotoxic effects.*

APHIDS (General open-feeding)

Aphids (General, open-feeding)

Chemical Control -	Rate (AI)	References
Diazinon EC	50 g/100 L	1,2
Dimethoate	see label	1,2,6,7
*Dutox	50 g/100 L	1
Malathion	50 g/100 L	1,2,5,6,7

	Rate (AI)	References
Permethrin EC	6-9 g/1&00 L	1,3,4,5
Pirimicarb	25 g/100 L	6,7
Pyrethrins PS	0.2%	-

*Formulated, trichlorfon + oxydemeton-methyl

Restrictions -

Dimethoate: May be toxic to Amelanchier, Prunus, and Ulmus spp. (1)

Malathion: Do not apply at air temperatures below 20°C.

References -

1. Drouin and Kusch, NFRC, Edmonton. Inf. Rep. NOR-X-81, 1974; NOR-X-131, 1975; NOR-X-150, 1976; NOR-X-184, 1977; NOR-X-213, 1979; NOR-X-227, 1980.
2. Kusch, NFRC, Edmonton, Pest Leaflet 10-76, 1978.
3. Howe and Worden, PFRA, Indian Head, Ann. Rep. 1977.
4. Neill and Worden, PFRA, Indian Head, Ann. Rep. 1978.
5. Neill, PFRA, Indian Head, Ann. Rep. 1980.
6. Reynard and Neill, PFRA, Ind. Head, Pest. Res. Rep. 1986: 165.
7. Reynard and Neill, PFRA, Indian Head, Pest Res. Rep. 1986: 170.

ASH PLANT BUG

Ash plant bugs

Chemical Control -

	Rate (AI)	References
Carbaryl WP	1.25 g/L	1
Resmethrin	0.25% pressurized spray	

References -

1. Neill and Eckstein, PFRA, Indian Head, Ann. Rep. 1984.

ASPEN BORER (Saperda calcarata)

Aspen borer
See POPLAR BORER on ASPEN (page 12 - 10).

BIRCH LEAF-MINING SPECIES

Birch leaf-mining species
- See LEAFMINERS (page 12 - 8).

BLISTER BEETLES

Blister beetles

Chemical Control -

	Rate (AI)	References
Carbaryl WP	1.25-1.6 g/L	1

References -

1. Neill and Reynard, PFRA, Indian Head, Ann. Rep. 1985.

BOXELDER BUG

Boxelder bug

Cultural Control -
Adults and nymphs can be controlled by spraying a 2% solution of a household dish detergent (5).

Chemical Control -

	Rate (AI)	References
Carbaryl WP	1.25-1.6 g/L	1,2,3
Trichlorfon SN	1.25 g/5L	1

References -

1. Mazurek et al., Proc. Entomol. Soc. Ont. 92:202, 1961.
2. Neill and Worden, PFRA, Indian Head, Ann. Rep. 1980.
3. Neill and Worden, PFRA, Indian Head, Ann. Rep. 1981.
4. Reynard and Neill, PFRA, Indian Head, Pest. Res.

Rep.1988:162.

5. Reynard and Neill, PFRA, Indian Head, Pest. Res. Rep. 1989 (In Press).

BOXELDER TWIG BORERS

Boxelder twig borers

Chemical Control -

	Rate (AI)	References
Dimethoate EC		
Soil drench	5.6 g/cm basal diam. applied mid-May in soil around drip lines; water in well	1
Foliage	50 g/100 L Apply in late July	1
Malathion EC		
Foliage	50 g/100 L	1

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

References -

1. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-131, 1975; NOR-X-184, 1977.

BRONZE BIRCH BORER

Bronze birch borer

Cultural Control -

Maintain birch in a healthy state by proper watering, fertilizing, and control of such insects as birch leaf miners. Infested trees showing advanced top and branch kill should be removed and destroyed during late fall to spring. On trees showing early signs of die-back and decline, prune 30-50 cm below all dead branches and tops in late fall and destroy.

CARPENTER WORMS AND ASH BORER

Carpenter worms & Ash borer

Cultural Control -
Damaged areas may be wrapped with burlap to prevent emergence of adults. (1)

References -
1. Peterson, PFRA, Indian Head, Sask., TN Pamphlet 2, 1971.

ELM BARK BEETLE, NATIVE SPECIES

Elm bark beetle, native species

Control of Dutch elm disease (DED) and the native elm bark beetle vector is achieved by an integration of several control methods:

Sanitation -	References
Remove and destroy (by chipping, burning, or burying in mineral soil) diseased, dying or recently killed elm trees, broken and dead branches and stumps with bark present to ground level. Trees salvaged for lumber or other wood products should not be stored with bark on or between April 1 and December 1. Avoid transport of infected material for firewood.	1,4
Cultural Control -	
Keep elms healthy by maintaining proper watering, fertilizing, insect control and pruning.	1,4

Chemical Control -	Rate (AI)	References
*Chlorpyrifos EC	0.5% aqueous solution	1,2,4
Methoxychlor E.......	4-12% solution	3

*Application of chlorpyrifos is by commercial use only. Thoroughly spray the lower 2.5 m of the trunks of living elms until the bark is wet in late summer to exclude over-wintering beetles from a D.E.D. control area. Spray the entire crowns of living elms in late-April to mid-May to give single season protection against branch feeding by adult beetles.

References -

1. Euale et al., GLFRC, Sault Ste. Marie. Inf. Rep. O-X-307, 1980.
2. Gardiner and Webb, GLFRC, Sault Ste. Marie, Inf. Rep. O-X-311, 1980.
3. Hildahl, NFRC, Winnipeg. Blue Jay, 35(2): 67,1977.
4. Hildahl, and Jeffrey, Man. Dept. Natl. Resources Publ., 1980.

FALL CANKERWORM AND SPRING CANKERWORM

Fall cankerworm & Spring cankerworm

Economic Threshold -

Control on first evidence of small "shot-holes" appearing on one or more branches.

Cultural Control -

Construct sticky tree bands around trunk before 1 April for spring cankerworms and before 25 September for fall cankerworms to prevent wingless females from ascending the tree to lay eggs. The sticky substance can be Tanglefoot or a suitable brand of axil grease. (1,2,4)

Biological Control -

	Rate	References
Bacillus thuringiensis var. *kurstaki* SU	0.02-1.1 billion I.U. /4.5 L or 8000 I.U./ mg	1,3

Chemical Control -

	Rate (AI)	References
Carbaryl WP....................	1.25-1.6 g/L	1,2,3
Methoxychlor EC	100 g/100 L	-

References -

1. Hildahl and Peterson, NFRC, Edmonton, Inf. Rep. NOR-X-100, 1974
2. Hildahl, NFRC, Edmonton, Pest Leaflet 3-75, 1975.
3. Reynard and Neill, PFRA, Indian Head, Pest. Res. Rep. 1988:164.
4. Neill and Reynard, PFRA Shelterbelt Centre Report 1989 (In Press).

FOREST TENT CATERPILLAR

Forest tent caterpillar

-- See TENT CATERPILLAR - (page 12 - 16)

LEAF BEETLES --(Elm, Poplar and Willow Leaf Beetles)

Leaf beetles - Elm leaf beetle, Poplar leaf beetle, and Willow leaf beetle

Chemical Control -

	Rate (AI)	References
Carbaryl WP	1.25-1.6 g/L	1

References -

1. Reynard and Neill, PFRA, Indian Head, Pest. Res. Rep. 1985:209.

LEAFHOPPERS AND PSYLLIDS

Leafhoppers & Psyllids

Chemical Control -	Rate (AI)
Carbaryl WP	1.25-1.6 g/L
Malathion EC	50 g/100 L
Methoxychlor EC	75 g/100 L
Pyrethrins PS	0.2%

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

Pyrethrins: Do not apply in direct sunlight, avoid wetting, and never spray food crops.

LEAFMINERS -- BIRCH, LILAC, OAK

Leafminers - Birch leaf miner species, Lilac leaf miner, Oak leaf miner

Economic Thresholds for Birch Leaf Miners -
Single season treatment may be desirable when 1 damaged leaf/branch tip of first generation (early June) is observed or two seasonal treatments if 1 or more leaves are mined/branch tip in previous year. Three seasonal treatments may be necessary when all 3 leaf-miner species are present.

Chemical Control -

	Rate (AI)	References
Acephate EC (birch)	25 g/100 L	1,3
Carbaryl WP (birch, oak)	50 g/100 L	-
Diazinon EC	50 g/100 L	2
Dimethoate	Follow label	1-3
Malathion EC	50 g/100 L	2

Birch leafminers: Dimethoate for soil drench treatment is applied at 4.5-5.6 g/cm of stem diameter and watered-in well according to label instructions. Apply bark paint-on treatment of dimethoate when first new leaves open fully (about 3rd week of May); repeat application about mid-June for control of second generation, painting the insecticide either above or below the first treatment. In areas where the two late-summer leaf mining species are also present, a third application in mid-July is required. (1). On foliage, make first application when leaves are fully open; repeat about mid-June and again in early July. Phytotoxicity of leaves may occur from soil drench treatment if not watered in well.

Lilac Leafminer: Treat when damage first seen.

Oak leafminer: Treat when damage first seen.

Restrictions -
Malathion: Do not apply at air temperatures below 20°C.

References -

1. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-205, 1978; NOR-X-213, 1979; NOR-X-227, 1980.
2. Kusch, NFRC, Edmonton, Pest Leaflet 9-76,1976.
3. Wong and Drouin, NFRC, Edmonton, Pest Leaflet 1-74, 1974.
4. Knowles and Beaubien, Pest. Res. Rep., 1982.

MOUNTAIN PINE BEETLE

Mountain pine beetle

Although mountain pine beetle is primarily a pest in pine forests, it may also invade urban, park and agricultural areas and infest ornamental, shade and shelterbelt-planted pines. Carbaryl 2% SN in water and MSM arsenic (systemic herbicide) are presently registered; the former for protection of high-value trees, the latter to kill bark beetle broods under the bark. However, proper application methodology is detailed and specific, and requires familiarity with the beetle to ensure success. Information on protection and control can be obtained through Forestry Canada (Pacific Forestry Centre, Victoria, B.C. or Northern Forestry Centre, Edmonton, Alta.).

NORTHERN PITCH TWIG MOTH

Northern Pitch twig moth

Cultural Control -

Remove resinous nodules manually on the main stem and destroy the single larvae that each contains.

PEAR SLUG

Pear slug

Economic Threshold -

Control when each of 5 leaves examined in late July contains one or more immature larvae.

Cultural Control -

Larvae can be removed from leaves with a strong jet of water from a garden hose. Effective control is also achieved by rinsing with a soapy solution. (1)

Chemical Control -

	Rate (AI)	References
Acephate EC	25 g/100 L	2
Carbaryl WP	25 g/100 L	1,2
Malathion EC	37-50 g/100 L	1,2
Pyrethrin	Pressurized spray	1
Rotenone	1% dust	1

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

References -

1. Drouin, NFRC, Edmonton, Pest Leaflet 2-75, 1978.
2. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-150, 1976; NOR-X-184, 1977; NOR-X-205, 1978.

POPLAR BORER ON ASPEN (*Saperda calcarata*)

Poplar borer on aspen (*Saperda calcarata*)

Borer infestations tend to vary directly with stem diameter and inversely with stocking of aspen stands (2,3). Infestations may concentrate in "brood trees" as larval tunnels increase annually (3). These provide infection courts for disease-causing fungi, especially Hypoxylon canker, and ultimately enhance the risk of stem breakage by wind (1,3). The poplar borer may be associated with carpenter worms (2). No chemicals are currently registered.

Cultural Control -

In small aspen woodlots or shelterbelts, peripheral heavily infested "brood trees" may be removed and destroyed before mid-June (2,3). Maintaining a heavy understory of other trees and shrubs appear to reduce risk of borer attacks. On trees with fresh sap exudate or boring frass, larvae in the wood can sometimes be killed by inserting a length of sharp flexible wire into the exit holes.

References -

1. Anderson and Martin, For. Sci. 27:461-476,1981.
2. Cottrell, Proc. Entomol. Soc. B.C. 59:33-34,1962.
3. Peterson, Ann. Rep. Entomol. Soc. Ont. 78:56-61,1945.

POPLAR BUD-GALL MITE

Poplar bud-gall mite

Cultural Control -

Thorough annual pruning and destroying of galls helps reduce populations. Future plantings should favour the more resistant varieties 'Walker', and 'Griffin' over the less resistant "Brooks #5" and "Northwest". Trees provided with adequate moisture, weed control, and fertilization can tolerate infestations of mites and gall development without major effects. (1-3)

Chemical Control -

No chemicals registered.

References -

1. Drouin, NFRC, Edmonton, Pest Leaflet 13-76, 1976.
2. Howard, Alta. Hort. Res. Centre, Brooks, Crop Protection Newsletter 1977.
3. Howe, PFRA, Indian Head Tree Nursery, Ann. Rep., 1977.

SAWFLIES - (Open-feeding defoliators)

Sawflies - (open-feeding defoliators)

Economic Threshold -

Larch:	Control when 5 or more of current year shoots are curled on 3-m tall trees. Shoots will bear eggs or newly hatched larvae.
Spruce:	Control when colonies of larvae are present on upper whorls of branches of trees, mostly less than 4 m tall.
Pine:	Control when 10 or more colonies of larvae are present on trees up to 3 m tall.
Willow:	Control when 10 or more colonies of larvae are present on shrubs up to 2 m tall.

Chemical Control -	Rate (AI)	References
Acephate EC	25 g/100 L	1
Carbaryl WP	25 g/100 L	5
Diazinon EC	25 g/100 L	1,4,5
Dimethoate	Follow label	1,3
*Dutox EC	25 g/100 L	1

	Rate (AI)	References
Malathion EC	50 g/100 L	2,4,5
Permethrin	6-9 g/100 L	1
Trichlorfon EC	25 g/100 L	1

*Formulated oxydemeton-methyl and trichlorfon

Restrictions -
Malathion: Do not apply at air temperatures below 20°C.

References -

1. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-184, 1977; NOR-X-205, 1978; NOR-X-227, 1980.
2. Hildahl and Peterson, Can. Forest. Serv., Winnipeg, MS-L-10, 1970.
3. Howe, PFRA, Indian Head, Ann. Rep. 1976.
4. Kusch, NFRC, Edmonton, Pest Leaflet 5-78,1975.
5. Reynard and Neill, PFRA, Indian Head, Pest. Res. Rep. 1987:173.

SCALE INSECTS (- European fruit lecanium, Oystershell scale, Pine needle scale, & Scrufy scale)

Scale insects - European fruit lecanium, Oystershell scale, Pine needle scale, & Scurfy scales

Economic Thresholds -

European Fruit Lecanium: Control when 25 or more scale insects attached/15 cm length of shoots.

Pine Needle Scale: Control when 1 or more branches has noticeable white scales on needles (i.e. one or more scales per needle of spruce and pine)

Chemical Control -

	Rate (AI)	References
Carbaryl WP	1.25-1.6 g/L	1
*Diazinon EC	50 g/100 L	-
Dimethoate	50 g/100 L	1
Kinoprene	10 g/100 L	-
*Malathion EC	50 g/100 L	1-3
Permethrin EC	6-9 g/100 L	-
Dormant oil EC	25 g/L	2

*Registered for oystershell and scurfy scale; applications at 1 week intervals starting June 1. (2)

Apply any of the above except diazinon to control European fruit lecanium and pine needle scale when crawler stage present; 5-20 June and mid-August for pine needle scale and about mid-July for European fruit lecanium.

Restrictions -
Malathion: Do not apply at air temperatures below 20°C.

References -

1. Kusch, NFRC, Edmonton, Pest Leaflet 16-77,1977.
2. Peterson, Can. Entomol. 92:851,1960.
3. Peterson and DeBoo, Can. For. Serv., Winnipeg, Note L-5,1969.

SPIDER MITES - on Spruce, Larch, Cedar and Juniper

Spider mites

Economic Threshold -
Control when foliage near the stem and in lower third of crown has Yellow-brown coloration and silken webbing plainly visible at close examination. Mite adults of green to brown coloration and 0.5 mm long should be visible to naked eye, especially against a white background.

Cultural Control -
Effective control can be achieved by flushing the affected foliage with a strong stream of cold water about every 14 days throughout the summer; this removes dead needles, webbing, dust and mite populations. Trimming the lower branches to increase light and air circulation will help to decrease mite buildup.

Chemical Control -

	Rate (AI)	References
Diazinon EC	50 g/100 L	1,3
Dicofol EC	37 g/100 L	1,2,3
Fenbutatin oxide WP	25 g/100 L	1
Malathion EC	50 g/100 L	1,3

Apply at nozzle pressure of 2100 kPa or greater to penetrate webbing. Usually 2 sprays required in a season; the first application during third week of May, the second in late June or July. Control may be enhanced by using a different insecticide for second application.

Restrictions -
Malathion: Do not apply at air temperatures below 20°C.

References -

1. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-150, 1976; NOR-X-213,1979; NOR-X-227,1980.
2. Peterson and Hildahl, Can. Forest. Serv., Winnipeg, L-7,1969.
3. Neill and Reynard, PFRA, Indian Head, Ann. Rep., 1984.

SPINY ELM CATERPILLAR

Spiny elm caterpillar

Chemical Control -

	Rate
Malathion EC	50 g/100 L

Restrictions -
Malathion: Do not apply at air temperatures below 20°C.

SPRUCE BUDWORM

Spruce budworm

Economic Threshold -
On a 45-cm branch tip from mid-crown level of spruce, 6-10 spring emerged larvae are sufficient to cause potential damage to 25-50% of openly exposed new shoots. Damage caused by fewer larvae would be negligible because of natural larval mortality factors. (2)

Biological Control -

	Rate	References
Bacillus thuringiensis var. *kurstaki* WP	0.02-0.1 billion I.U. /4.5 L or 8000 I.U./mg	1,3,4

Apply Bt after most of new shoots have flushed or lost their bud caps and larval development has reached peak third and fourth instars.

Chemical Control -

	Rate (AI)	References
Dimethoate EC	50 g/100 L	1
Methomyl (forestry use)	Follow label	1
Permethrin EC	6-9 g/100 L	-
Triclorfon 4 EC	Follow label	1,5

References -

1. Canusa, Data Fact Sheet, February 1982.
2. Cerezke, NFRC, Edmonton, File Rep., 1977.
3. Morris et al., FPMI, Sault Ste. Marie, Ont, Rep. FPM-X-47,1981.
4. Morris et al., FPMI, Sault Ste. Marie, Ont, Rep. FPM-X-53,1982.
5. Reynard and Neill, PFRA, Indian Head, Pest. Res. Rep. 1986:167.

SPRUCE GALL APHIDS

Spruce gall aphids

Economic Threshold -
Control required on spruce less than 3 m tall, when 10 brown galls were formed the previous year, or 2 or more branches bear numerous visible white cottony specks on the needles in the spring.

Cultural Control -
Remove the galls by hand as they are forming.

Chemical Control -

	Rate (AI)	References
Carbaryl WP	1.25 g/L	1
Malathion 50	50 g/100 L	1

Apply insecticide in early May before bud break.

Restrictions -
Malathion: Do not apply at air temperatures below 20°C.

References -

1. Caltrell, NFRC, Edmonton, Pest Leaflet, 12-76, 1976.

TENT CATERPILLARS

Tent caterpillars

Economic Threshold (for Forest tent caterpillar) -
On trees up to 3 m tall, one egg band per tree (each band may contain 150-250 eggs), or, following egg hatch, one larval colony per tree. On trees of 7 cm or more stem diameter, 7 or more egg bands per tree.

Cultural Control -
On ornamentals, remove egg bands during late to early spring, or remove young larval colonies after hatch.

Biological Control -

	Rate	References
Bacillus thuringiensis var. *kurstaki* SU........	0.02-0.1 billion I.U. /4.5 L or 8000 I.U. /mg	1,2,4,7

Chemical Control -

	Rate (AI)	References
*Carbaryl WP	1.25-1.6 g/L	1,2,4,6
Deltamethrin	4.5 g/100 L	5,6
Diazinon EC	50 g/100 L	1
*Malathion EC	50 g/100 L	1,2,4,6
*Methoxychlor EC	50 g/100 L	1,2,4
Permethrin	6-9 g/100 L	-
Trichlorfon EC	50 g/100 L	1,3

*Registered for caterpillars on fruit trees.

Restrictions -

Malathion:	Do not apply at air temperatures below 20°C.
Deltamethrin:	For commercial use by ground in the Prairie Provinces and Peace River District of B.C . DO not use at temperatures above 25°C. Do not apply more than three times per season.

References -

1. Drouin and Kusch, NFRC, Edmonton, Inf. Ref. NOR-X-81, 1974; NOR-X-131,1974; NOR-X-150,1976; NOR-X-184, 1977; NOR-X-205,1978.
2. Hildahl, Can. For. Serv., Winnipeg, Pest Leaflet 17-77,1977.
3. Hildahl and Bowden, NFRC, Winnipeg, File Report, 1976.

4. Hildahl and Campbell, Can. For. Serv., Winnipeg, Inf. Rep. NOR-X-135,1975.
5. Stephen, Pest. Res. Rep., 1984:211.
6. Reynard and Neill, PFRA, Indian Head, Pest. Res. Rep. 1987:165.
7. Neill and Reynard, PFRA, Indian Head, Pest. Res. Rep.1989 (In Press).

TERMINAL WEEVILS

Terminal Weevils (spruce and pine)

Cultural Control-

Remove and destroy infested terminals in early July and prune uppermost whorl of branches, leaving 1 of small diameter to develop into new leader. (1,2)

References -

1. Sundaram et al., CCRI, Ottawa, Inf. Rep. CC-X-31, 1972.
2. Turner et al., Ont. Min. Nat. Res., Pub. PC-3, 1975.

UGLY-NEST CATERPILLAR

Ugly-nest caterpillar

Cultural Control -

Destroy nests or tents containing larval colonies about the third week in May by pruning. (1)

References -

1. Still, NFRC, Edmonton, Pest Leaflet 11-76,1976.

WARREN ROOTCOLLAR WEEVIL

Warren Rootcollar weevil

Cultural Control -

Grubs on root-collar base are located in resinous channels in the bark and can be readily removed by hand by first pulling away organic matter around tree and locating the galleries. Removal of organic litter around tree base discourages attacks. (1)

References -

1. Cerezke, NFRC, Edmonton, Inf. Rep., A-27,1970.

WILLOW SHOOT-BORING SAWFLY

Willow shoot-boring sawfly

Chemical Control -

	Rate (AI)	References
Dimethoate	6.25 g/cm stem diam.	1,2

Apply as soil drench around willow plants and water in well.

References -

1. Drouin, NFRC, Edmonton, Pest Leaflet 24, 1978.
2. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-150, 1976; NOR-X-184, 1977; NOR-X-205, 1978.

SEASONED WOOD AND TIMBER STRUCTURES

H.F. Cerezke

CARPENTER ANTS

Carpenter ants

Preventive Control -

Carpenter ant colonies may establish in stumps, unhealthy or dead trees, and in various interior and exterior buildings wood structures such as studs, rafters, baseboards, door casings and other support structures. Exterior decaying structures are particularly vulnerable and should be replaced. Outside stacked wood materials should be removed or examined annually for colony establishment, and not placed adjacent to buildings.

Chemical Control -

	Rate	References
Carbaryl	5% dust	1
Diazinon	0.5%	1
Propoxur	1%	1
Resmethrin	0.25%	-

Locate and determine the extent of excavated cavities in wood structures from the small exuded piles of "sawdust", by "sounding", and by drilling fine holes. Inject or blow dust or sprays into holes near the top of cavities and into other cracks and crevices used as exit holes, or onto ant trails leading to and from the structure. Dusts are usually more effective than sprays.

References -

1. Agric. Can. Publ. 1736/E, 1982-1983.
2. Ostaff, East. For. Prod. Lab. Rep. OPX101E, 1974.
3. Ruppel, PFRC, Victoria For. Pest Leaflet No. 58,1973.

POWDERPOST BEETLES

Powderpost beetles

Dry, seasoned, manufactured and unrotted coniferous and hardwoods may be attacked by a variety of species, and more commonly in coastal B.C. areas than in the interior or prairie provinces. Most occurrences are in hardwoods in furniture, flooring, decorative trim, carved ornaments and other exotic wood products. Small circular holes and fine boring sawdust are diagnostic signs.

Cultural Control -

Expose infested material to heat (above 60°C) or to freezing temperatures for several hours. Unfinished material can be protected by varnishing, painting, coating with linseed oil or wax, or by using acceptable wood preservatives. Heavily infested material should be destroyed or replaced.

References -

1. Furniss and Carolin, USDA Misc. Publ. No. 1339,1977.
2. Ruppel, Pass and Wiens, PFRC, Victoria, Publ. FPL29, 1975.

SAWYER BEETLES

Sawyer beetles

Sawyer beetles attack newly killed or severely weakened coniferous trees, mostly within the first year following death. The larvae bore tunnels into the wood and may be present for one to three years.

Preventive Control -

Process newly cut logs into lumber or other wood products within a few months after cutting. Remove bark of fresh-killed trees by early June.

Direct Control -

Expose infested logs to 60-71°C for two or more hours.

Chemical Control -	Rate
Lindane EC	0.4% solution

Apply lindane to entire bark surface in early June to prevent egg laying, and to kill eggs and young larvae, already present.

References -

1. Cerezke, NFRC Rep. NOR-X-129,1975.
2. Ostaff and Cech, East, For. Prod. Lab. Rep. OPX200E, 1978.

TERMITES (in British Columbia only)

Pacific dampwood termite & Western subterranean termite

Termites feed in wood structures, especially coniferous materials and may eventually cause weakening or collapse of the structure. Favoured locations include: coniferous forests; dead trees; stumps, logs, or various wood structures; and partially decayed or mechanically damaged wood material in contact with the ground or moist substrate.

Preventive Control -

Clear stumps or piled wood away from buildings. Maintain dry soil conditions under and around buildings by clearing debris to increase ventilation. All wood support structures should not be in direct contact with moist soil, or should be treated with appropriate wood preservatives. Outside wooden structures such as fences, sidewalks, etc., should be separated from houses and other buildings. Maintain annual inspection for evidence of the presence of termites.

References -

1. Ruppel, PFRC, Victoria, For. Pest. Leaflet No. 57, 1972.

TURF

M. Dolinski

(i.e. lawns and recreational areas not grazed by livestock)

Important: Mow the lawn before treatment.

ANTS

Ants

Chemical Control -

	Rate (g AI/100 m^2)
Carbaryl	90-125/140-180 L
Chlorpyrifos (Commercial)	10
Diazinon	40-75/45-90 L

Restrictions -

Carbaryl: Do not water for 2 days after treatment and repeat in 2-3 weeks if necessary.
Chlorpyrifos: Thoroughly water the lawn after treatment.
Diazinon: See chlorpyrifos.

EARTHWORMS

Earthworms

Chemical Control -

	Rate (g AI/100 m^2)	References
Carbaryl	125	1-3

Apply uniformly in 90 L of water then water thoroughly.

References -

1. Doane, J. Econ. Entomol. 55:3,1962.
2. Peterson, Pest. Res. Rep. 1964:151.
3. McDonald, Pest. Res. Rep. 1971:202.

GLASSY CUTWORM

Glassy cutworm

Chemical Control -

	Rate (g AI/100 m^2)
Chlorpyrifos	10
Diazinon	30

Restrictions -
Only 2.5% chlorpyrifos granular, a commercial product, is registered for this purpose.

SOD WEBWORM

Sod webworm

Chemical Control -

	Rate (g AI/100 m^2)
Carbaryl	90-125
Chlorpyrifos	40-75
Diazinon	10

Restrictions -
Carbaryl: Do not water in.
Chlorpyrifos: Do not water for 12-24 hours after treatment.
Diazinon: Water in well.

WHITE GRUB

White grub

Chemical Control -

	Rate (g AI/100 m^2)
Chlorpyrifos	10
Diazinon	75

Apply treatment between late July and early October.

Restrictions -
Chlorpyrifos: Keep off lawns until dry. Some formulations require watering after treatment.

WAREHOUSE AND FARM STORED GRAIN

N.D.G. White

WAREHOUSE INSECTS

- Confused flour beetle, Dermestid beetles, Hairy spider beetle, Merchant grain beetle, Red flour beetle, Spider beetle

Chemical Control -

	Rate	References
*Malathion	2% spray	4
*Pyrethrins + piperonyl butoxide	0.1% + 1.0%	10

*Apply at 5 $L/100\ m^2$ to floor and lower half of walls of warehouses every 7 to 28 days during March-August.

Note: Malathion and pyrethrins are less effective on concrete than on wood surfaces (8). Pyrethrins generally breakdown quickly.

STORED GRAIN INSECTS AND MITES

- Dermestid beetles, Foreign grain beetle, Fungus beetles, Granary weevil, Hairy spider beetle, Lesser mealworm, Meal moth, Psocid, Red flour beetle, Rusty grain beetle, Saw-toothed grain beetle, Storage mites.

Chemical Control -

Empty bin sprays -	Rate	References
+*Malathion - premium grade	1% or 2.5-3%	1,4 1A
*Pyrethrins + piperonyl butoxide	0.1% + 1.0%	10
Dichlorvos (DDVP-350 ULV)........	16 g/2 L oil at 2 mL/m^3	1

* Apply 5 $L/100\ m^2$ to floors and walls of empty, cleaned granaries. + In granaries to be used for rapeseed storage, apply malathion only to infested locations usually at floor and wall junctions (11,12).

Note: Malathion should be used 2-4 weeks before introducing grain. However, it may be used 1 day prior to storing grain. Dichlorvos is applied by thermal or mechanical fogger at ultra low volumes.

Diatomaceous Earth (Silicon Dioxide): a compound called "Insecto", (and others) which is 80% silicon dioxide has been registered for control of stored-grain insects in empty grain bins, silos, box cars, and warehouses mainly as a crack and crevice treatment. The material provides a physical method of control. The recommended application rate is 500 g/100 m^2, in localized areas, which forms a relatively dense layer of dust. Warning - repeated exposure to this fine dust may result in pulmonary disease. Silicon dioxide is registered for use on animal-feed grains and seeds, only, at 500 g/tonne seed.

Prevention or control in stored wheat, oats, or barley -

Malathion grain protectant	Rate	References
0.5% dust	1.6 kg/tonne	5
1.0% dust	0.8 kg/tonne	-
2.0% dust	0.4 kg/tonne	-
Malathion - premium grade 83.6% EC	10 mL in 0.5 -0.8 L water /tonne	9

Note: Malathion is more effective in dry grain than in tough or damp grain where rapid breakdown occurs (5). The Canadian Grain Commission does not recommend the use of grain protectants (1). Cooling grain through aeration is the preferred management practice.

Restrictions -

Do not apply to grain within 7 days of selling for premium grade, deodorized grain protectant or 60 days for standard malathion grades (check label).

Malathion: Preparation and Application.

Prepare a 1% malathion spray from premium grade deodorized emulsifiable concentrate (83.6%) by using the following formula: (83.6-1)/1 = 82.6. Therefore, use 1 part of concentrate for every 82.6 parts of water. (7)

Determine the flow rate of grain through the auger.

Use a pressurized sprayer or any other suitable applicator, such as a homemade drip device (3), to apply the 1% spray continuously to the grain stream as it is discharged from the spout or as it enters the auger tube.

Flow rate (wheat)				Application rate (spray)			
per hour		per minute		per hour		per minute	
metric tons	metric bushels	tons	bushels	litres	gal	litres	gal
3	110.4	0.050	1.84	2.4	0.54	0.04	0.009
6	220.2	0.100	3.67	4.8	1.08	0.08	0.018
9	330.6	0.150	5.51	7.2	1.56	0.12	0.026
12	441.0	0.200	7.35	9.6	2.10	0.16	0.035
15	551.2	0.250	9.19	12.0	2.88	0.20	0.048

Determine the rate at which the pressurized sprayer or other type of applicator discharges insecticide. A needle valve may have to be fitted to regulate the flow of spray from the nozzle of the sprayer or gravity flow applicator. For example, to treat 13.5 metric tons of wheat (500 bu.), 10.8 litres of 1% spray are needed. If it takes an hour to auger the grain, the sprayer must discharge the insecticide at 10.8/60 = 0.18 litres (6.3 fl oz) per minute.

Feeding Treated Grain To Livestock

According to the Abell-Waco label, grain treated with 50% EC malathion applied at recommended rates, should not be fed to livestock for at least 2 months after treatment. According to the American Cyanamid label for Cythion, grain treated with formulations made from 83.6% or 50% premium-grade malathion should not be used as livestock feed for at least 60 days.

Fumigation -

Safety Measures - Fumigants are poisons; take extreme precautions when they are used.

Do not enter a structure that is under fumigation. Wait for at least 13 days before opening a farm structure that has been under fumigation. Most fumigants will have escaped by 5 days but a further 7 day waiting period is advised.

Stay up-wind from the fumigant while the fumigant is added to grain going into the auger as a bin is being filled with grain.

Read the labels on the containers - Follow the manufacturer's recommendations.

Wear protective clothing and gloves. A gas mask with a fresh canister should be used.

Do not fumigate when the commodity is below 5°C.

Treatment of cereals -

Seal the grain bin as well as possible with caulking and masking tape before putting the infested grain in the bin -- leaks of fumigant gas reduce the effectiveness of the fumigation and present a hazard to people and animals immediately down-wind from the fumigated bin.

Preferably, mix the fumigant with the infested grain as well as possible under the circumstances. To do this, add the fumigant to the grain as it is being augered into a bin. It may be necessary to transfer grain from one bin to another.

Auger holes are a problem. Add some fumigant to the auger hole at the end of the fumigation -- and seal the door.

Solid Fumigants* -

	Rate	References
Phosphine gas............... (Aluminum phosphide)	4 tablets or 8 pellets/ m^3 grain ($1m^3$ = 28 bushels)	1,2

*For all grains and oilseeds apply the tablets or pellets while augering the grain into a clean and well-caulked bin, wait 13 days before opening the storage structure. Use the entire volume of the bin, including the headspace, in dosage calculations.

The Canadian Grain Commission Inspectors' Manual entitled "Stored Grain Pests" provides the following temperature, dosage, and exposure time data for solid fumigants such as phosphine.

	Minimum Exposure Period	
Temperature°C	Dosage per m^3	Days
Above 20	4 tablets or 8 pellets	3
15-20	4 tablets or 8 pellets	4
11-14	5 tablets or 10 pellets	7
4-10*	5 tablets or 10 pellets	10

*Below 10°C, fumigation is not advisable in structures that are not air-tight.

After fumigation aerate all products at least 48 hours (i.e., open all doors and vents, and use aeration fans if available).

Turning grain in cold weather -
Auger 'heating' grain to another bin during winter. Several transfers may be needed to lower grain temperature to below freezing. (6)

LESSER MEALWORMS

Lesser Mealworms - are occasionally found in grain and animal feed. Because they are relatively large, they are readily visible and therefore appear to be more serious than they actually are.

Malathion or pyrethrins may be used to control these insect in grain; however, carbaryl (1A), tetrachlorovinphos (Disvap 50, Gardona), or Boric acid 98% (Darkling Beetle Dust; cracks and crevices), are registered for use against this species in poultry barns. Carbaryl may be applied to floors at a rate of 1.25 Kg. WP in 100 L of water.

FUNGUS BEETLES

Fungus Beetles - are controlled by the same treatments recommended for rusty grain beetles and other species associated with stored grain. However, these beetles do not feed on grain but rather on fungi associated with grain. Thus, their presence indicates that the grain is deteriorating. Although insecticide treatment will control the fungus beetles, it will not correct the underlying problem of deterioration. As soon as grain producers detect these beetles, they should immediately turn their grain to break up lumps of heating grain and if the moisture content exceeds 14.5% the grain should be dried or aerated before placing it back into storage.

References -

1. Anon., Stored Grain Pests Supplement to the Official Grain Inspectors' Manual. Can. Grain Comm. Winnipeg. 1989.

1A. Anon., Manitoba Agriculture. Insect control Guide. 1988.

2. Monro, FAO Agr. Studies No. 79,381 pp. 1969.
3. Quinlan, White, Wilson, Davidson and Hendricks. J. Econ. Entomol. 72:90-93.1979.
4. Tauthong and Watters, J. Econ. Entomol. 71:115-121.1978.
5. Watters, J. Econ. Entomol. 53:341-349.1959.
6. Watters, J. Econ. Entomol. 56:215-219.1963.

7. Loschiavo, Agric. Can. Pub. 1595,1984.
8. Watters, J. Econ. Entomol. 69: 353-356.1976.
9. Watters and Bickis, J. Econ. Entomol. 71:667-669.1978.
10. Watters and Sellen, J. Econ. Entomol. 49:280-281.1956.
11. White and Abramson, J. Econ. Entomol. 77:289-293.1984.
12. White, J. Econ. Entomol. 78:1315-1319.1985.

HAZARDS AND SAFEGUARDS IN APPLYING INSECTICIDES TO CROPS IN BLOOM

J. Soroka And D. Murrell

CAUSES OF BEE POISONING

Causes of bee poisoning

Most bee poisoning occurs when insecticides are applied to crops during the blooming period. Other hazards are:

- drift of toxic sprays or dusts onto adjoining crops that are in bloom
- bees coming into contact with insecticide residues on plants
- bees drinking or touching contaminated water on foliage or flowers or from empty pesticide containers
- bees collecting contaminated pollen or nectar
- bees collecting unused pesticide dust or spray

BEEKEEPER-GROWER CO-OPERATION

Beekeeper-grower co-operation

A major consideration for the reduction of bee poisoning is beekeeper-grower co-operation. The beekeeper often depends on the grower for bee forage and the grower depends on the beekeeper for pollination. Co-operation and understanding of each other's problems are essential.

REDUCTION OF BEE POISONING

Reduction of bee poisoning

What Can A Pesticide Applicator Do

(1) Do not apply insecticides that are toxic to bees on crops or weeds in bloom.

(2) Apply certain chemicals only in late evening when bees are not actively foraging (see following table).

(3) Ground application is generally less hazardous than aerial application because there is less drift of the pesticides and smaller areas are treated at one time.

(4) Do not dump unused dusts or sprays where they might become a bee-poisoning hazard. Sometimes bees collect any type of fine dust material when pollen is not readily available. Under such conditions, they may actually carry pesticide dusts back to the colony.

(5) Use insecticides that are relatively non-hazardous to bees whenever such choices are consistent with other pest control considerations.

(6) Notify beekeepers in the area of your application plans at least 48 hours before applying hazardous pesticides.

What The Grower Can Do

(1) Learn the pollination requirements of the crops you raise. Application of insecticides hazardous to bees on these crops or driving beekeepers out of your area by the use of insecticides on other blossoming crops may contribute to poor yields.

(2) When insect pests have been damaging a crop every season, use a preventive program of monitoring and early season application before pest population increase, foliage growth, and weather conditions reduce the effectiveness of insecticides.

(3) Learn about the beekeeper's problems with chemical poisoning and enter into mutually advantageous agreements to produce bee-pollinated crops.

What the beekeeper can do

(1) Give a map of apiary locations to your municipality office, extension agrologist, local aerial applicators, and the provincial apiculturist.

(2) Post your name, address, and phone number in printing large enough to be read at some distance in all apiaries so that you can be contacted readily to move the colonies when hazardous sprays are to be applied.

(3) If possible, choose apiary sites which are relatively isolated from intensive insecticide applications and which are not normally subjected to drift of chemicals.

(4) Cover honey bee colonies with plastic or tarpaulin to protect them from direct contact with insecticide during application.

SAFEGUARDING BEES

Safeguarding bees

If an insecticide has been applied to a crop to control pest insects and leafcutters are ready but have not been released, the incubator temperatures can be lowered to about 10°C and the bees held until the poisonous residue has disappeared from the crop (see following table). Shelters can be covered or closed during application of short-residual insecticides to prevent drift of insecticides into shelters. In extreme northern areas bees may not get back to the shelters at night so evening application of insecticides is not advisable. Apply recommended insecticides during the bloom period after foraging has ceased on warm evenings only, to allow the bees good flight conditions to return to the shelters.

Do not apply insecticides to blooming crops or weeds. Do not allow insecticide dusts or sprays to drift onto bumble bee nest sites or blooming plants on which wild bees are foraging.

Field Application Hazard of Insecticides to Bees[a]

Insecticide	Hazard Rating[b] Honey bee	Hazard Rating[b] Leafcutter bee	Residue Hazard[c] (days)
acephate	1	1	2.5
aldicarb,soil granular	1	1	none
azinphos-methyl	1	1	5
Bacillus thuriengiensis	3	3	none
bendiocarb	1	-[d]	-
carbaryl	1	1	3-7
carbaryl (Sevin XLR)	2	2	6
carbofuran F	1	1	3-5
carbofuran G	3	3	none
carbophenothion	2	2	1
chlorfenvinfos	3	-	-
chlorpyrifos	1	1	2-3.5
deltamethrin	2	2	1
demeton	2	2	1
diazinon	1	1	1-2
dichlorvos	1	1	-
dicofol	3	3	none
dimethoate	1	1	7
endosulfan	2	1	2
fensulfothion	1	-	-
fenthion	1	-	-
fenvalerate	1	1	1
fonofos	2	-	-
lindane	1	-	-
malathion EC	2	1	2 (6-LCB)
malathion D or ULV	1	1	-
methamidophos	1	1	1
methidathion	1	1	7
methomyl	1	1	1.5
methoxychlor EC	2	2	0.5
mevinphos	1	1	1-1.5
naled	1	1	1-1.5
oil sprays	2	-	-
oxydemeton methyl	2	2	0.5
permethrin	1	1	5
phosphamidon	1	1	2-5
pirimicarb	2	2	0.5
propoxur	1	1	-
pyrethrum	3	-	none
rotenone	3	-	none
tetradifon	3	2	0.5
trichlorfon	2	2	0.5

[a] Most of these chemicals have not been tested for bee toxicity under Western Canadian conditions; the data herein are for a general guideline only.

[b] Field application where bees are, or will be, foraging

1. Very poisonous to bees; do not apply to crops or weeds in bloom unless bees are kept off for the period that residue on the crop is a hazard.
2. Moderately poisonous to bees; may be applied with minimum hazard in the evening when bees are not foraging.
3. Not very poisonous to bees; may be applied with minimum hazard to bees.

[c] Residue hazard represents the average time in days that residue poisonous to honey bees will remain on the foliage.

[d] - indicates no data available.

References -

1. Atkins et al., Reducing Pesticide Residues to Honey Bees, Univ. Calif., Leaflet No. 2883,1981.
2. Craig, Pest. Res. Rep. 1973:168.
3. Craig, Pest. Res. Rep. 1985:141.
4. Johanson, How to Reduce Bee Poisoning from Pesticides, Wash. State Univ., Western Region Extension Publication No. 15, 1983.
5. Pesticide-pollinator interactions, Rept. Assoc. Comm. Sci. Crit. Environ. Qual., Nat. Res. Council Can., No. 18471, 1981.

APPENDIX I

The following insecticides **WERE NOT REGISTERED** for these specific uses at the time this report was prepared (October 1989) but, otherwise, would be acceptable to the Committee at the rates indicated. However, these uses must not be recommended unless specified on registered product label.

Appendices I and II must not be copied if reproductions are made of the WCCP recommendations.

CEREAL CROPS AND GRAIN CORN

ARMYWORMS

Armyworms

Chemical Control -

	Rate (g AI/ha)
Deltamethrin	7.5

Restrictions -
Deltamethrin: Do not use at temperatures above 25°C.

EUROPEAN CORN BORER

European corn borer

Chemical Control -

	Rate (g AI/ha)	Preharvest Intervals	References
Deltamethrin	12.5-17.5	-	-

Restrictions -
Deltamethrin: Do not use at temperatures above 25°C.

ORANGE WHEAT BLOSSOM MIDGE

Orange wheat blossom midge

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
Endosulfan	400-560	-	-

OILSEED CROPS

CUTWORMS (sunflowers)

Cutworms

Chemical Control -

	Rate (g AI/ha)	References
Deltamethrin	10	1

References -

1. Catellier et al., Pest. Res. Rep. 1984.

FLEA BEETLE (rape)

Flea beetle

Chemical Control -

	Rate	References
Isofenphos	0.3 g/kg seed	1,2
Endosulfan	560 g AI/ha	3
Cloethocarb (granular)....... -granules mixed with seed at time of planting	280 g AI/ha	4,5,6

References -

1. Philip and Steiner, Pest. Res. Rep. 1979:206.
2. Westdal et al., Pest. Res. Rep. 1978:257; 1979:195, 200; 1980:112.
3. Wise, Pest. Res. Rep. 1983.
4. Lui, Pest. Res. Pep.1980:120.
5. Romanow & Askew, Pest. Res. Rep. 1982:86; 1983:85; 1984:101.
6. Westdal et al.,Pest. Res. Rep. 1980:112; 1981:110,114.

FORAGE CROPS

PEA APHID

Pea aphid

Chemical Control -

	Rate (g AI/ha)
Deltamethrin	7.5-10

COMMERCIAL VEGETABLE CROPS

LETTUCE APHIDS

Lettuce aphid

Chemical Control -

	Rate (g AI/ha)	References
Disulfoton	1100	1,2

References -

1. Vernon and Mackenzie, Pest. Res. Rep. 1985:97.
2. Vernon and Mackenzie, Pest. Res. Rep. 1986:82

GREENHOUSE VEGETABLE CROPS

THRIPS (Cucumbers)

Thrips - (cucumbers)

Chemical Control -

	Rate (AI)	References
Deltamethrin	1.75 -2.5 g/100 L	1

Note: Some concern regarding possible increase in larval production with use of deltamethrin.

Reference -

1. Steiner, Pest. Res. Rep. 1985:203, 205.

BERRY CROPS

CHOKECHERRY FRUIT INSECTS

Chokecherry fruit insects

Chemical Control -

	Rate (AI)	References
Acephate EC	25 mL/100 L	1
Diazinon EC	25 mL/100 L	1
Dimethoate EC	25 mL/100 L	1
Malathion EC	25 mL/100 L	1
Oxydemeton-methyl EC	25 mL/100 L	1
Propoxur EC	25 mL/100 L	1
Resmethrin	Follow label	1

Apply insecticide between start and end of petal fall. Controls both midge and sawfly. Phytotoxicity may occur with excessive application. Apply to blossoms as late as possible to avoid bee kill.

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

References -

1. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-81, 1974; NOR-X-150, 1976; NOR-X-184, 1977; NOR-X-213, 1979.

LEAFROLLERS (blueberries)

Leafrollers on blueberries

Chemical Control -

	Rate g AI/ha	Preharvest Interval	References
Deltamethrin	5.0-7.5	14 days	1

Restrictions -
Deltamehrin: Do not apply at air temperatures above 25°C.

References -

1. Raine, J. and Clements S.J., Pest Res. Rep. 1985:34.

SASKATOON FRUIT INSECTS

Saskatoon fruit insects

Chemical Control -

	Rate (AI)	References
Acephate EC	25 mL/100 L	1
Diazinon EC	25 mL/100 L	1
Oxydemeton-methyl EC	25 mL/100 L	1
Permethrin EC	9.5 mL/100 L	1
Propoxur EC	25 mL/100 L	1
Deltamethrin	5-7.5 g/ha	2
Trichlorfon 4 EC	25 mL/100 L	1

Apply insecticide between start and end of petal fall. Apply when most of the petals have fallen. Phytotoxicity may occur with excessive application. Apply as late as possible to avoid bee kill.

References -

1. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-213, 1979; NOR-X-227, 1980.
2. Davidson and Neighbour, Ag. Canada, Beaverlodge. 1985

APHIDS (General open-feeding)

Aphids (General, open-feeding)

Chemical Control -

	Rate (AI)	References
Deltamethrin	0.045 g/100L.	1,2

References -

1. Reynard and Neill, PFRA, Indian Head, Pest. Res. Rep.1986:165.
2. Reynard and Neill, PFRA, Indian Head, Pest. Res, Rep. 1986:170.

ASH BARK BEETLE

Ash bark beetle - three possible species

Chemical Control -

	Rate (AI)	References
Carbaryl	2% solution in water	
Chlorpyrifos	0.5% solution in water	
Methoxychlor	4-12% solution in water	

NOTE: These are unregistered insecticides for ash bark beetle treatment and are suggested here for control of the adult stage. Apply solution to lower 0.5m of mature ash trees in early September to reduce overwintering beetle populations. Though undocumented, the insecticides appear to control ash bark beetles similarily as for elm bark beetles.

ASH PLANT BUG

Ash plant bug

Chemical Control -

Rate (AI)	References	
Diazinon EC	50 g/100 L	1
Deltamethrin EC.	1.1 g/100 L	2
Dimethoate EC	50 g/100 L	1

Apply to foliage when leaf damage first seen.

References -

1. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-66, 1973; NOR-X-150,1976.
2. Reynard and Neill, PFRA, Indian Head, Pest. Res. Rep. 1985:207.

BLISTER BEETLES

Blister beetles

Chemical Control -

	Rate (AI)	References
Deltamethrin EC	1.5 g/100 L	2
Malathion EC	50 g/100 L	1,2

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

References -

1. Howe, PFRA, Indian Head, unpubl. data, 1976.
2. Neill and Reynard PFRA, Indian Head Ann. Rep. 1985.

BOXELDER BUG

Boxelder bug

Chemical Control -

	Rate	References
Cypermethrin EC	2.5 g/100 L	4
Diazinon EC..................	60 g/100 L	5
Dimethoate EC................	50 g/100 L	1,5
Methoxychlor EC	50 g/100 L	1,2
Permethrin EC	6 g/100 L	3
Insecticidal Soap	1kg/100 L	6

References -

1. Howe, PFRA, Indian Head, Ann. Rep., 1977.
2. Neill and Worden, PFRA, Indian Head, Ann. Rep. 1978.
3. Neill and Worden, PFRA, Indian Head, Ann. Rep. 1979.
4. Neill and Worden, PFRA, Indian Head, Ann. Rep. 1981.
5. Reynard and Neill, PFRA, Indian Head, Pest. Res. Rep.1988:162.
6. Reynard and Neill, PFRA, Indian Head, Pest. Res. Rep. 1989 (In Press).

EUROPEAN FRUIT LECANIUM

European fruit lecanium

Chemical Control -

	Rate	References
Diazinon EC	50 g/100 L	1
*Dutox EC	50 g/100 L	1

*Formulated, trichlorfon + oxydemeton-methyl.

Apply to crawler stage after 15 July.

References -

1. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-184, 1977.

CARPENTER WORM AND ASH BORER

Carpenter worm & Ash borer

Chemical Control -

	Rate (AI)	References
Diazinon	0.6 g/L	1
Carbaryl	3.0 g/L	1

On high value trees locate gallery entrances marked by fresh boring frass in spring. Apply 2.5 ml into each hole with an eye dropper.

References -

1. Solomon, J. Econ. Entomol. 78;485-488,1985

LEAF BEETLES - (Elm, poplar, and willow feeding species)

Leaf beetles - (Elm, poplar and willow feeding species)

Chemical Control -

	Rate (AI)	References
Deltamethrin EC	1.5 g/100 L	2
Dimethoate EC	50 g/100 L	-
	Rate (AI)	References
Malathion EC	50 g/100 L	1,2
Methoxychlor EC	50 g/100 L	1

Restrictions -

Dimethoate: May be phytotoxic to Amelanchier, Prunus, and Ulmus spp.
Malathion: Do not apply at air temperatures below 20°C.
Deltamethrin: Do not apply at air temperatures above 25°C.

References -

1. Howe, PFRA, Indian Head, Ann. Rep., 1976.
2. Neill & Reynard, PFRA, Indian Head, Pest Res. Rep. 1985:209.

LEAF MINERS (on poplar)

Leaf miners (on poplar)

Chemical Control -

	Rate (AI)	References
Carbaryl (WP)	0.5-1.6 g/L	--
Acephate	25 g/100 L	--
Diazinon	50 g/100 L	--

Apply insecticide in late May or early June, similarly as for birch leaf miner

MOUNTAIN PINE BEETLE

Mountain pine beetle

Pre-emergence treatment for control of mountain pine beetle in single trees or small tree groupings.

Chemical Control -

	Rate (AI)	References
Chlorpyrifos	1-2% solution	1
Carbaryl	1-2% solution	1

Apply 1 L of mixture/sq meter of bark surface to height of 2-4 meters or to a height where the diameter is about 12 cm. Apply in early July to the point of run off to all sides of the stem.

References -

1. Fuchs and Borden, J. Econ. Entomol. 1985.

PEAR SLUG

Pear slug

Chemical Control -

	Rate (AI)	References
Dimethoate EC	5.6 g/cm stem diam.	1

Apply as soil drench in early July; water in well.

References -

1. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-131, 1975; NOR-X-150,1976; NOR-X-205,1978.

ROSE CURCULIO

Rose curculio

Chemical Control -

	Rate (AI)	References
Carbaryl	1.25-1.6 g/L	-

Cultural Control -
Adults can be hand picked during morning sunny periods.

RUSTY TUSSOCK MOTH

Rusty tussock moth

Chemical Control -

	Rate (AI)	References
Diazinon EC	50 g/100 L	1

SAWFLIES - (Open-feeding defoliators)

Sawflies (open-feeding defoliators)

(currant, larch, pines, spruces and willow)

Chemical Control -

	Rate (AI)	References
Deltamethrin	0.045 g/100L.	3
Dimethoate	Follow label	1,2
Fenvalerate EC	25 g/100 L	1
Methoxychlor EC	50 g/100 L	1
Resmethrin	0.25% pressurized spray	1

Apply to foliage when young larvae first seen.

References -

1. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-81, 1974; NOR-X-131, 1975; NOR-X-150, 1976; NOR-X-184, 1977; NOR-X-205, 1978; NOR-X-213, 1979.
2. Howe, PFRA, Indian Head, Ann. Rep., 1976.
3. Reynard and Neill, PFRA, Indian Head, Pest. Res. Rep., 1987:172.

SPIDER MITES - (on spruce, larch, cedar and juniper)

Spider mites (on spruce, larch, cedar and juniper)

Chemical Control -

	Rate (AI)	References
Dimethoate EC	50 g/100 L	2
Omite WP	10 g/L	1
Pirimor WP	50 g/100 L	1

Apply as foliar sprays about mid-July.

References -

1. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-150,1975; NOR-X-213, 1979; NOR-X-227,1980.
2. Neill and Reynard, PFRA, Indian Head, Ann. Rep., 1984.

SPINY ELM CATERPILLAR

Spiny Elm Caterpillar

Chemical Control -

	Rate (AI)	References
Diazinon EC	50 g/100 L	

SPRUCE BUDWORM

Spruce Budworm

Chemical Control-	Rate (AI)	References
Deltamethrin	0.045 g/100L	1

References-

1. Reynard and Neill, PFRA, Indian Head, Pest. Res. Rep.1986:167

SPRING CANKERWORM

Spring Cankerworm

Chemical Control -	Rate(AI)	References
Deltamethrin	0.045g/100L	1

References-

1. Reynard and Neill, PFRA, Indian Head, Pest. Res. Rep. 1988:164.

TERMINAL WEEVILS

Terminal weevils (spruce and pine)

Chemical Control -

	Rate (AI)	References
Methoxychlor EC	2-3% solution	1,2

Spray leaders of open-planted trees less than 6 m tall about mid-May.

References -

1. Sundaranm et al., CCRI, Ottawa, Inf. Rep. CC-X-31,1972.
2. Turner et al., Ont. Min. Nat. Res., Publ. PC-3,1975.

UGLY-NEST CATERPILLAR

Ugly-nest caterpillar

Chemical Control -

	Rate (AI)	References
Dimethoate EC	50 g/100 L	1
*Dutox EC	50 g/100 L	1

*Formulated, trichlorfon + oxydemeton-methyl.
Apply in April to overwintered egg clusters.

References -

1. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-150, 1976.

WARREN ROOTCOLLAR WEEVIL

Warren Rootcollar Weevil

Chemical Control -

	Rate (AI)	References
Dimethoate	11 g/cm stem diam.	1

Apply as soil drench and watered in well.

References -

1. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-131,1975; NOR-X-205,1978.

WILLOW RED GALL SAWFLY

Willow red gall sawfly

Chemical Control -

	Rate (AI)	References
Carbaryl (WP)	1.25 g/l	1

Spray willows 3 days after first emergence of adults, about mid to late May, and repeat 10 days later. Monitor for adults with yellow sticky traps (1).

References -

1. Neill & Reynard, PFRA, Indian Head, Ann. Rep., 1983.

APPENDIX II

Appendix II contains Temporary Registered and Registered insecticides that, in the opinion of the committee, require more efficacy data.

CEREAL CROPS

ARMYWORM

Armyworm

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval
Chlorpyrifos	420-580	60

EUROPEAN CORN BORER

European corn borer

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval
Carbofuran (FL)		
Grain ,silage corn	530	7
Chlorpyrifos		
Grain corn	1120	70
Permethrin (G)		
Grain corn	100	N/A

Restrictions -

Carbofuran: Do not apply more than four times per season. Do not apply within seven days of harvest. Cobs, husks, and stalks may then be fed to livestock.

GRASSHOPPERS

Grasshoppers

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval
Azinphos-methyl	275-425	30
Deltamethrin (2.5 F.) aerial application	4	
Methamidophos	550	10

Restrictions -

Deltamethrin: Do not graze on treated fields. Do not make more than three application per year(only two applications per year by air).

Do not apply at temperatures above 25°C. Best control is obtained if application is made when the grasshoppers are in the 2-4 nymphal stage.

RUSSIAN WHEAT APHID

Russian wheat aphid

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval
Chlorpyrifos	480	60
Dimethoate	210	2
Malathion	700	7

WIREWORMS

Wireworms

Chemical Control -

	Rate (g AI/ha)
Fonofos G	
Broadcast	4450
Band	1130-1460

Restrictions -
Fonofos: Check label for rates for various row spacings.

OILSEED CROPS

BERTHA ARMYWORM

Bertha armyworm

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
Cypermethrin	50-70	30	-

Restrictions -
Cypermethrin: Avoid application at temperatures above 27°C. (Only one application by air).

DIAMONDBACK MOTH

Diamondback moth

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
Chlorpyrifos	500-575	21	1

References -
1. Jurus, Pest. Res. Rep. 1985.

GRASSHOPPERS

Grasshoppers

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval	References
Chlorpyrifos	280-420	21	-

FORAGE CROPS

PEA APHID (alfalfa)

Pea aphid

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval
Demeton	275	21
Oxydemeton-methyl	425-550	-

Restrictions -
Oxydemeton-methyl: Do not pasture or use crop for feed.

COMMERCIAL VEGETABLE CROPS

EUROPEAN CORN BORER

European corn borer

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval
Carbofuran	530	7
Permethrin (G)	100	

Granules to be applied to the leaf axils.

ONION MAGGOT

Onion maggot

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval
Chlorpyrifos (in the furrow at planting)		
Onion, dry	2.5 g/100 m row	141
Onion, pickling	2.5 g/100 m row	97

GREENHOUSE ORNAMENTALS

APHIDS

Aphids

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval
Bendiocarb (Trumpet)	60-80	1

Restrictions -
Allow 24 hours after treatment before re-entering treated areas.
Gloves should be worn when working with treated foliage.

MEALYBUGS

Mealybugs

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval
Bendiocarb (Trumpet)	60-80	14

Restrictions -
Allow 24 hours after treatment before re-entering treated areas. Gloves should be worn when working with treated foliage.

WHITEFLIES

Whiteflies

Chemical Control -

	Rate (g AI/ha)	Preharvest Interval
Bendiocarb (Trumpet)	60-80	14

Restrictions -
Allow 24 hours after treatment before re-entering treated areas. Gloves should be worn when working with treated foliage.

ASH BORER

Ash borer

Chemical Control -

	Rate (AI)
*Chlorpyrifos EC	500 g/100 L
Endosulfan EC + ethion EC	45 + 23 g/100 L

Spray stems about 21 May and again mid-June.

*Note: Chlorpyrifos: commercial use only; apply to infested limb and trunk for control of ash borer and lilac borer.

APPENDIX III

INDEX OF COMMON NAMES OF COMPOUNDS USED IN THIS REPORT VERSUS TRADE NAMES.

Common Name	Trade Name
Acephate	ORTHENE
AFUGAN	Pyrazophos
Aldicarb	TEMIK
ALLETHRIN	Pyrethrins
ALTOSID	Methoprene
AMBUSH	Permethrin
AMMO	Cypermethrin
APM	Azinphos-methyl
ATOX	Rotenone
Azinphos-methyl	APM, GUTHION
Bacillus thuringiensis	DIPEL, THURICIDE, NOVABAC III
BASUDIN	Diazinon
BAYGON	Propoxur
BELMARK	Fenvalerate
BELT	Chlordane
Bendiocarb	FICAM, TRUMPET
BIRLANE	Chlorfenvinphos
BRIQUETS	Methoprene
BUTOCIDE	Piperonyl butoxide
Carbaryl	SEVIN
Carbofuran	FURADAN
Chlordane	CHLORDANE, BELT
Chlorfenvinphos	BIRLANE
Chlorpyrifos	LORSBAN, DURSBAN
CINERIN	Pyrethrins
Cloethocarb	LANCE
COUNTER	Terbufos
CYGON	Dimethoate
Cyhexatin	PLICTRAN
CYMBUSH	Cypermethrin
Cypermethrin	RIPCORD, AMMO, CYMBUSH
CYTHION	Malathion
DASANIT	Fensulfothion
DDVP	Dichlorvos
DECIS	Deltamethrin
Deltamethrin	DECIS
Demeton	SYSTOX
DERITOX	Rotenone

Common Name	Trade Name
DI-SYSTON	Disulfoton
Diatomaceous Earth	INSECTO
Diazinon	BASUDIN, DIAZINON, SPECTRACIDE
DIBROM	Naled
Dichlorvos	DDVP, VAPONA
Dicofol	KELTHANE
Dienchlor	PENTAC, SATHON
Dimethoate	CYGON, ROGOR, SYS-TEM, HOPPER-SPRAY, HOPPER-KILL, HOPPER-TOX HOPPER STOPPER
DIPEL	*Bacillus thuringiensis*
Disulfoton	DI-SYSTON
Dormant oil	Dormant oil
DRIONE	Silica gel
DURSBAN	Chlorpyrifos
DUTOX	Trichlorphon + Oxydementon-methyl
DYFONATE	Fonofos
DYLOX	Trichlorfon
Endosulfan	THIODAN
Ethion	ETHION
Fenbutatin-oxide	TORQUE, VENDEX
Fensulfothion	DASANIT
Fenvalerate	BELMARK
FICAM	Bendiocarb
Fonofos	DYFONATE
FURADAN	Carbofuran
GAMMA BHC	Lindane
GAMMA HCH	Lindane
GUTHION	Azinphos-methyl
HOPPER-KILL	Dimethoate
HOPPER-SPRAY	Dimethoate
HOPPER STOPPER	Dimethoate
HOPPER-TOX	Dimethoate
IMIDAN	Phosmet
INSECT SMOKE FUMIGANT	Sulfotep
Insecticidal Soap	SAFER'S INSECTICIDAL SOAP
INSECTO	Diatomaceous Earth
Isofenphos	OFTANOL
JASMOLIN	Pyrethrins
KELTHANE	Dicofol
KORLAN	Ronnel

Common Name	Trade Name
LANCE	Cloethocarb
LANNATE	Methomyl
Lindane	GAMMA BHC, GAMMA HCH
LORSBAN	Chlorpyrifos
Malathion	CYTHION, MALATHION
MARLATE	Methoxychlor
MESUROL	Methiocarb
Metaldehyde	SLUG BAIT, SNAIL BAIT
METASYSTOX-R	Oxydemeton-methyl
Methamidophos	MONITOR
Methidathion	SUPRACIDE
Methiocarb	MESUROL
Methomyl	LANNATE
Methoprene	ALTOSID, BRIQUETS
METHOXOL	Methoxychlor
Methoxychlor	MARLATE, METHOXOL, METHOXYCHLOR
Mevinphos	PHOSDRIN
MONITOR	Methamidophos
MULTIPURPOSE TETRALITE	Resmethrin
N-Propanol	N-Propanol
Naled	DIBROM
NEGUVON	Trichlorfon
NICOTINE SULFATE	1,2-nicotine sulfate
NO-MOLT	Teflubenzuron
NOVABAC III	*Bacillus thuringiensis*
OFTANOL	Isofenphos
OMITE	Propargite
ORTHENE	Acephate
Oxydemeton-methyl	METASYSTOX-R
Parathion	PARATHION
PENTAC	Dienochlor
Permethrin	AMBUSH, POUNCE
Phorate	THIMET
PHOSDRIN	Mevinphos
Phosmet	IMIDAN, PROLATE
Phosphine	PHOSTOXIN
PHOSTOXIN	Phosphine
Piperonyl butoxide	BUTOCIDE
Pirimicarb	PIRIMOR
PIRIMOR	Pirimicarb
PLANTFUME 103	Sulfotep
PLICTRAN	Cyhexatin
POUNCE	Permethrin
PROLATE	Phosmet
Propargite	OMITE

Common Name	Trade Name
Propoxur	BAYGON
Pyrazophos	AFUGAN
PYRETHRIN	Pyrethrins
Pyrethrins	CINERIN, JASMOLIN, PYRETHRIN, ALLETHRIN
Resmethrin	MULTIPURPOSE TETRALITE
RIPCORD	Cypremethrin
ROGOR	Dimethoate
Ronnel	RONNEL, KORLAN
Rotenone	ATOX, DERITOX, ROTENONE
SAFER'S INSECTICIDAL SOAP	Insecticidal Soap
SATHON	Dienochlor
SBP-1382	Resmethrin
SEVIN	Carbaryl
Silica gel	DRIONE
SLUG BAIT	Metaldehyde
SNAIL BAIT	Metaldehyde
SPECTRACIDE	Diazinon
Sulfotep	Plantfume 103, Insect Smoke Fumigant
SUPRACIDE	Methidathion
SYS-TEM	Dimethoate
SYSTOX	Demeton
TEDION	Tetradifon
Teflubenzuron	NO-MOLT
TEMIK	Aldicarb
Terbufos	COUNTER
Tetradifon	TEDION
THIMET	Phorate
THIODAN	Endosulfan
THURICIDE	*Bacillus thuringiensis*
TORQUE	Fenbutatin-Oxide
Trichlorfon	DYLOX, NEGUVON, TRICHLORPHON
Trichlorfon + oxydemeton-methyl	DUTOX
TRUMPET	Bendiocarb
VAPONA	Dichlorvos
VENDEX	Fenbutatin-oxide

APPENDIX IV

SUBCOMMITTEES FOR 1990

Cereal crops and grain corn	D.L. Johnson, O. Olfert
Oilseed crops	R.A. Butts
Forage crops	B.D. Schaber, M. Okuda
Special Crops	J. Jones
Household pests	M. Steiner, L. Harris
Home vegetable crops	L. Harris
Commercial vegetable crops	R.S. Vernon, J. McCullough
Greenhouse crops Ornamentals and vegetables	M. Steiner, J. McCullough
Interior Plantscapes and House plants	M. Steiner, J. McCullough
Mushrooms	R.S. Vernon, D. Smith
Berry crops	M.S. Okuda, R.S. Vernon
Shelterbelts, ornamental trees, and shrubs	G.B. Neill, H.F. Cerezke
Seasoned wood and timber structures	H.F. Cerezke
Turf	M. Dolinski
Warehouses and farm-stored grain	N.D.G. White
Insecticide Use and Bee Safety	J.Soroka, D. Murrell

ADDRESSES ON NEXT PAGE

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GUIDELINES FOR ADDITIONS OR REVISIONS TO WCCP GUIDE

The following guidelines are suggested for making submissions for additions or revisions to the WCCP guide.

1. Submissions to be forwarded to the appropriate Subcommittee Chairman or the Subcommittee Chairman would approach companies for data to support additions by September 15.

2. Subcommittee reviews submissions using the following criteria.

    (a) Product and use must be registered under the PCP Act.

    (b) Experimental data in support of the submission, to be obtained from laboratory and Western Canadian field evaluations with induced and/or natural infestations, conducted according to acceptable research practices regarding replication, reproducibility, checks and standards comparability, statistical design and analyses, and interpretation of results.

    (c) Documented references, either published or not.

    Note: Criteria would not necessarily apply to additions or revisions to Household, Greenhouse, Greenhouse Woody Ornamentals, Household and Home Greenhouse Plants, and Turf Sections.

APPENDICES

1. Products that are not registered but are proven effective as per criterium 2, may be included in Appendix I.

2. Products that are registered but require more data on performance may be included in Appendix II.

3. Subcommittee Chairman recommends acceptance or rejection of submission to WCCP.

4. Western Committee on Crop Pests accepts or rejects recommendation.

Committee: Harvey Craig, Bill Charnetski,
Ed Thiessen, Mike Dolinski,
Dave Smith